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Popular Science

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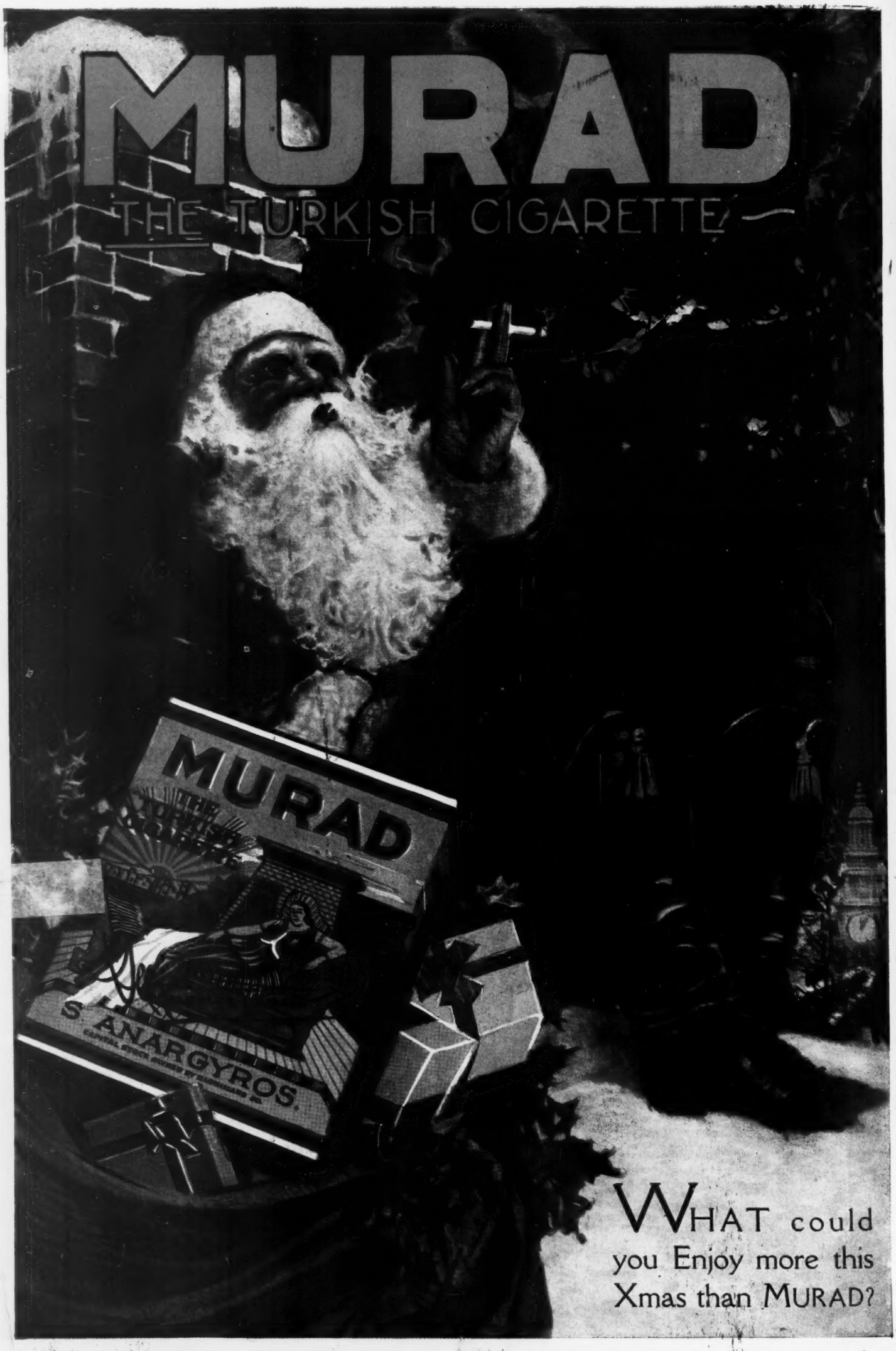
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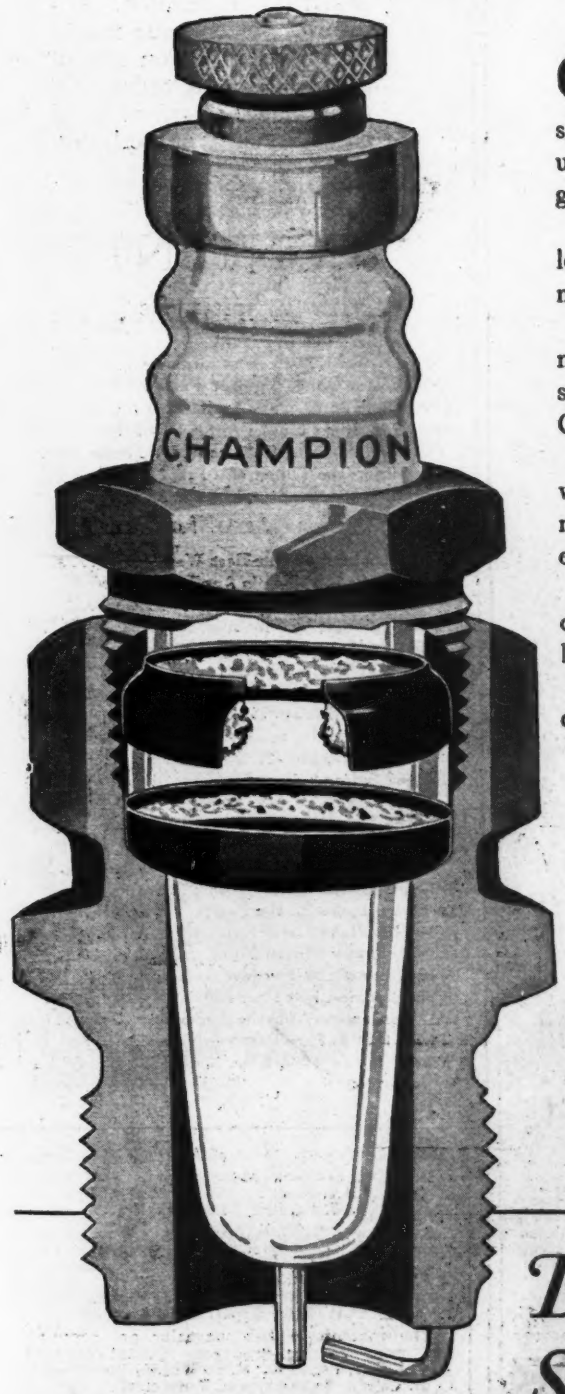

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Popular Science Monthly

DEC., 1920

Volume 97-No. 6

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Five Miles High in a Tank

Showing how lack of oxygen produces aviators' brain fag

By Walter Bannard

A CROSS-EYED, one-legged man of sixty may be a good sea-captain; but a twenty-five-year-old dyspeptic will be a failure as an air-pilot. Because a man has flown a few times he is no more fitted to be an air-pilot than a fourteen-year-old girl who has taken a few piano lessons is justified in competing with Hofmann.

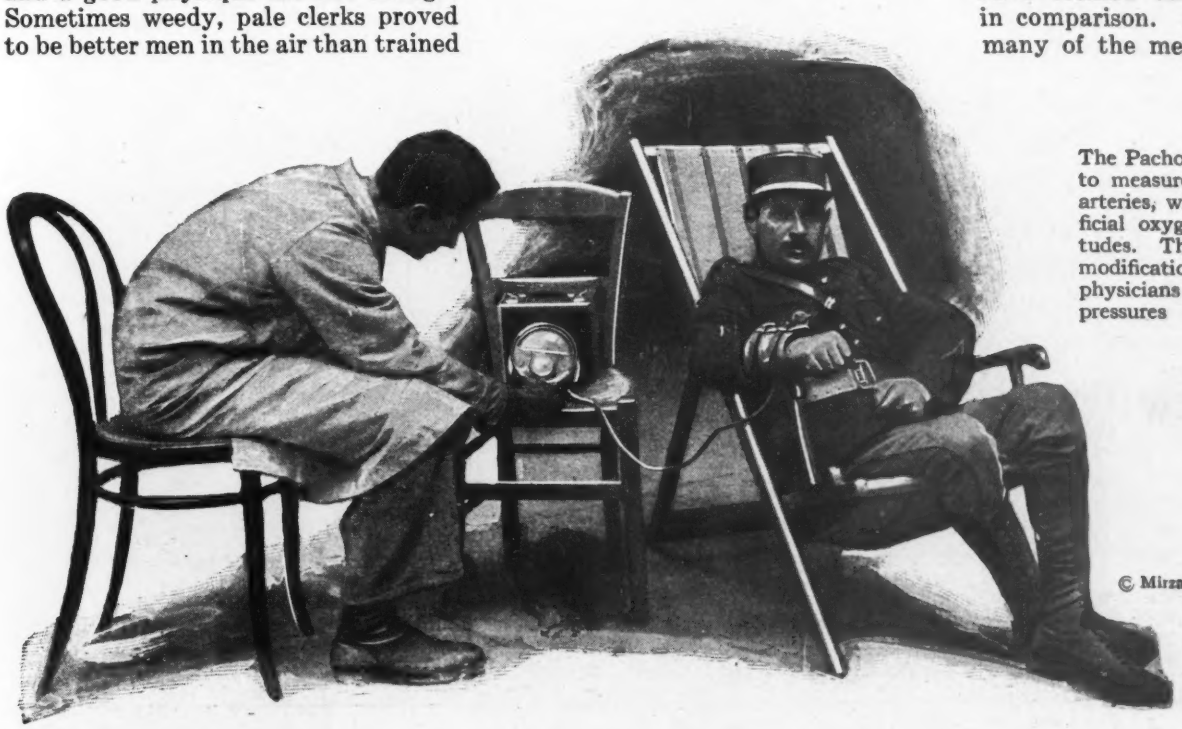
Who is fit to guide a flying-machine through the air? The Germans in the early days of the war used to select their flyers from the cavalry. English athletes and polo-players proved to be good airmen. Some of our best flyers were once automobile and motorcycle racers.

But the rigorous test of war proved quickly enough that athletic prowess and a good physique are not enough. Sometimes weedy, pale clerks proved to be better men in the air than trained athletes who had learned to handle a flying-machine.

As the war progressed it became apparent that recruits for the flying service must be scientifically selected. The fate of an army depended on the character of the men who fought at great heights, photographed the enemy positions, or watched the fall of shells. Moreover, it was an expensive business to train a flyer and then to find him unfit.

It is said that it cost the American government as much as $50,000 to fit a man to fly; but the figure must surely include the damage sustained by the training airplane. At all events, it was known long before we entered the war that the British lost 95 per cent of their airmen, not from bullets, but from physical defects. A taint of epilepsy, the slightest tendency to vertigo, persistent headache, nervousness, and easily induced fatigue were sure to prove the undoing of a brave man in the air.

So it came about that applicants for the air service were systematically studied, both psychologically and physically, to discover latent disabilities. Men were whirled in chairs to test their sense of equilibrium; their eyes were examined; their family history was inquired into; their chest expansion was measured; their height and weight were noted. If all the ideals set up could have been met by any of the applicants, Apollo would have seemed an imperfect weakling in comparison. As a matter of fact, many of the men who were rejected



The Pachon oscillometer is used to measure the tension of the arteries, with and without artificial oxygen, at different altitudes. The instrument is a modification of that used by physicians to measure blood pressures

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by our own army entered the Canadian Royal Flying Corps and gave a good account of themselves.

Not so long ago the conscience of a United States Army medical officer troubled him because he discovered that the best flyer in his camp had flat feet!

Another flyer of unquestionable ability had slightly defective vision in one eye. Two medical examiners have been known to scratch their heads for half an hour because an applicant, acceptable in every other respect, had a chest expansion one quarter of an inch less than the standard.

Now that we have entered the period of commercial flying, it becomes more than ever necessary to determine the fitness of a man to pilot a flying machine.

What is wanted is not that extraordinary product, the ace, but a high average type.

It is doubtful whether much reliance can be placed on the whirling-chair test. Psychological tests, however, are certainly important. It takes a man from nineteen hundredths to twenty hundredths of a second to make up his mind to carry out an act in an emergency—his reaction time. This reaction time may be delayed by fatigue, drugs, and excesses. On the other hand, it is found to be somewhat lower at times in men who are physically fit than in others.

After a man loses his head there is usually no time for correction in the air. Hence the French may be right in rejecting an applicant who is too slow by even the infinitesimal part of a second.

When a pilot loses his head, he may move the throttle the wrong way; he may keep his engine running full speed when he should throttle down; he may switch off the power entirely when he needs all the speed that he can command.

Brain Fag Breeds Indifference

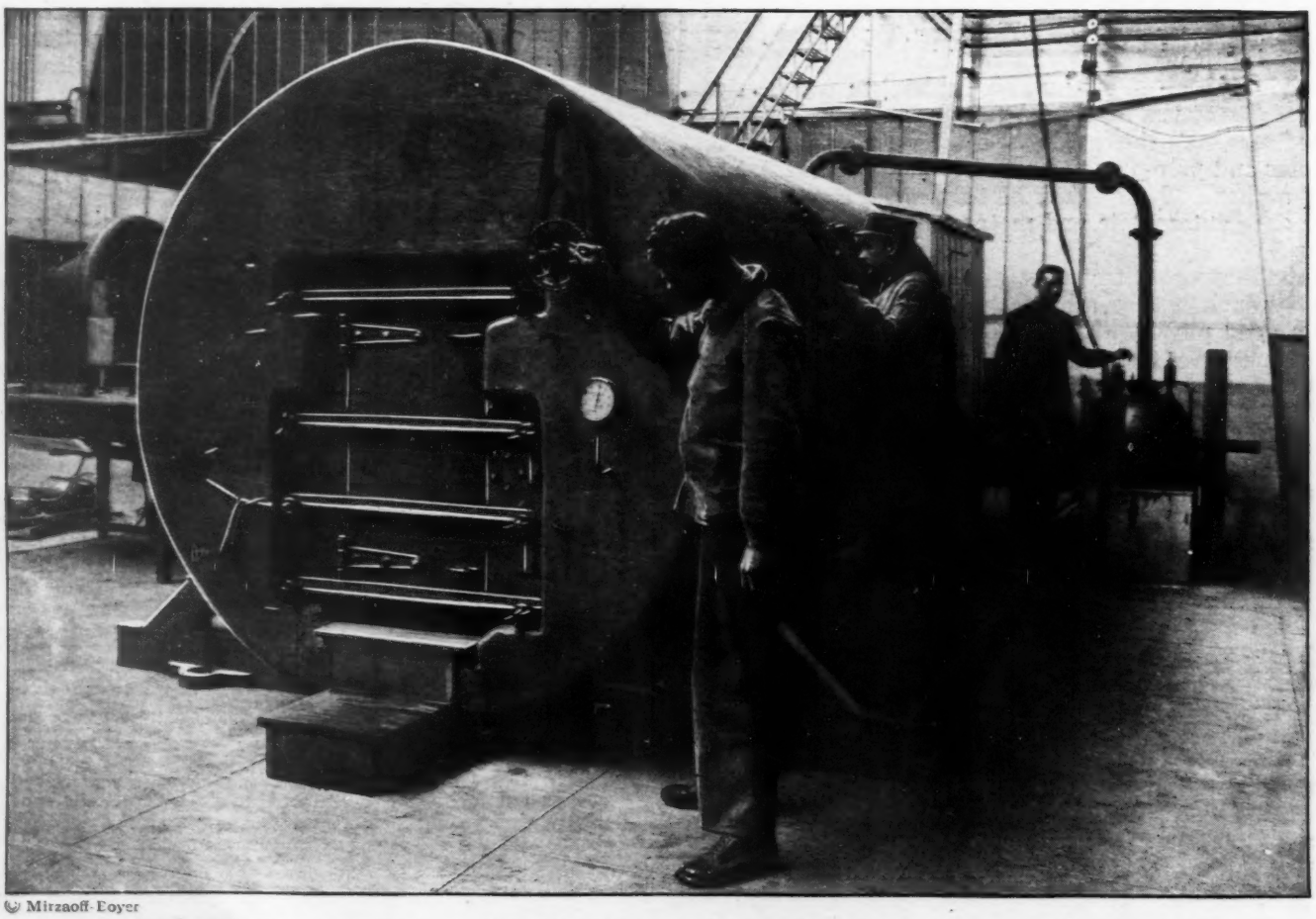
Fatigue—above all, brain fatigue—may prove as fatal as a poor reaction time.

When the brain is fagged out the man has neither the power nor the reason to decide and act. This is probably due to the many impressions received by the brain during flight. He feels alone. He is not afraid. He is simply appalled by the enormity of the enterprise in which he is engaged. Helpless, stupefied, he awaits events and takes little part in the control of his machine.

It is altogether likely that fast passenger-carrying airplanes of the future will fly at altitudes far above those at which the highest battles were fought in the air. We are told that above an altitude of thirty thousand feet and more the winds are in the nature of planetary swirls into which a machine should be guided in order to gain an advantage in speed and in economy of power.

Now, the human organism was evolved to live on the earth, not above it. As a man goes up, the total quantity of air in a lungful decreases. He must breathe faster. At nineteen thousand feet he inhales only one half the amount of oxygen and nitrogen that he breathes at sea-level. At less than twenty-five thousand feet the lack of oxygen becomes distressing.

The human organism has the ability of adapting itself to changed conditions, but only within limits. How far it can thus compensate itself depends on the man. Before the flyer's limit of compensation is reached, he feels dizzy. Yet he is perfectly happy, although he has lost his faculty of judgment and has passed into a condition of partial or total unconscious-



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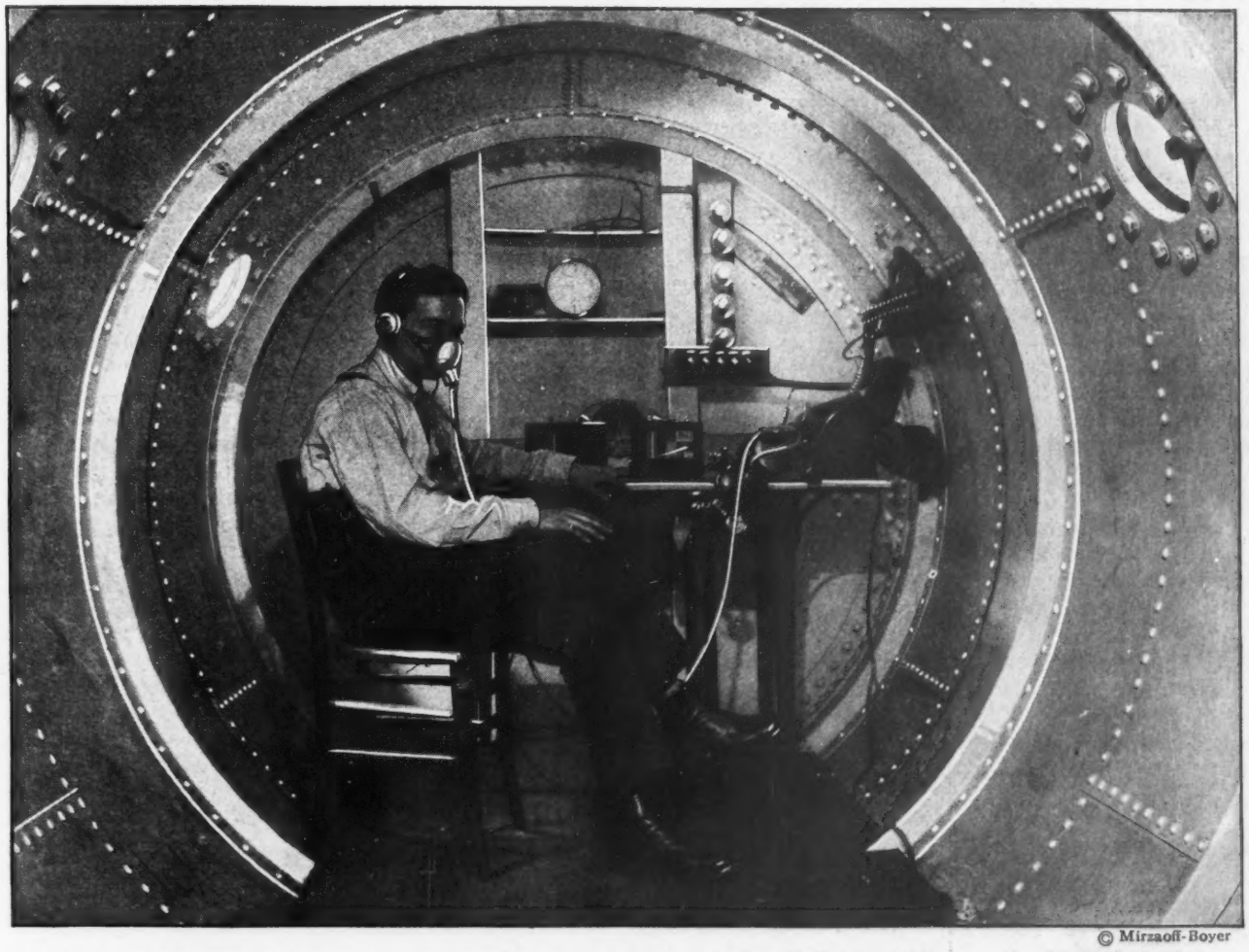
This is the tank that is used at the Aerotechnical Institute of Saint-Cyr, France, to test prospective air-pilots. On the next page the interior of the tank is shown. In the background is a pump by means of which some of the air is removed within the tank so as to produce conditions similar to those at high altitudes



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The man who wants to become an aviator takes his seat within the tank. Air is pumped out to any desired degree. Thus the man is artificially elevated to ten, twenty, or thirty thousand feet

The man in the picture wears an oxygen mask, so that he is quite comfortable, even though he may be in an atmosphere equivalent to that of five miles altitude. Various instruments record his condition

ness. "I'm all right," he says as he flies along at fifteen or twenty thousand feet. But the tests show that every one of us is affected more or less at such heights. It takes longer to judge and to act; it is harder to read an instrument. Positions of objects are misjudged. Pain itself loses some of its poignancy. Excessive fatigue, nausea, and vertigo assert themselves.

For these reasons the oxygen tank has become an indispensable part of the high flyer's equipment. All the recent records of Rohlfs and Schroeder were made with the assistance of oxygen. It is not impossible that in the high-flying passenger-carrying airplane of the future the crew and the passengers will sit in hermetically sealed compartments filled with oxygen supplied from tanks. Otherwise passengers must wear oxygen masks.

Often a pilot crashes at the end of a rapid descent. He has no recollection of what happened; he lost consciousness and was actually asleep. This is highly significant; for this is a state that is induced by an ample supply of oxygen or fresh air at full pressure after a period of degradation. It is a phenomenon often met with by students of the low-oxygen problem. It occurs in a wide variety of conditions—in miners escaping damp, in city firemen after coming out of smoke, in the older type of submarines on opening the hatches after submergence, in persons who are given oxygen after overexertion on a mountain and after low-oxygen experiments in the laboratory. But in none of these conditions are the consequences so serious as for the aviator.

The Value of the Oxygen Tank

Oxygen plays such an important part in flying that one of the most important tests of physical fitness consists in discovering how a man will behave when he is partially deprived of it. The man is not carried up into the air to be tested, partly because it is unnecessary to do so and partly because the conditions there are against scientific observation. He is placed in a tank from which some of the air is pumped. Thus it is possible to climb, barometrically speaking, to any desired height.

These tanks are now employed by the medical officers of all armies. By their means the truth about a great many airplane accidents has been deduced.

The subjects vary in every conceivable way. The man who has a "weak heart" is usually found at the bottom of the list; he can stand very little oxygen reduction. At the other extreme is the man whose powers of compensation are so good that he can "go up" in the tank to twenty-five thousand feet and show but a slight change in adaptability from the normal.

In these airtight testing chambers, or tanks, from six to ten men can be tested at a time, if need be. Oxygen can be inhaled from a tube, with the result that, although the artificial altitude may be thirty thousand feet, the faculties are normal. The effect of high altitude on the heart, breathing, and nerves without oxygen can be noted. All the effects of a fall are obtained by allowing the air to enter the tank rapidly. Thus the barometric conditions that obtain during an actual flight can be imitated.

Trapped in a Sunken Submarine

How I drilled through steel for eight hours to save the crew of the S-5

By William G. Grace

Chief Engineer of the Steamship "General G. W. Goethals"

THE bell in the engine-room rang with the signal to stand by, which meant that I was wanted on deck. When I got there, I found the captain looking hard at a ship that was standing off on our starboard side. To men familiar with the sea, a ship is just a ship, but this one had something strange about her. It looked as if something was strung almost upright across her bow.

"What's that against her bow?" asked the captain, handing me the glasses.

I looked carefully, but the light was none too good—it was getting close to six o'clock in the evening, and the best I could make out from our distance was an object that looked like an airplane strung over the ship's side and resting in the water.

"That's no airplane," said the captain. "She wouldn't have an airplane in that position."

Then, as we drew closer to the vessel, the startling truth became known.

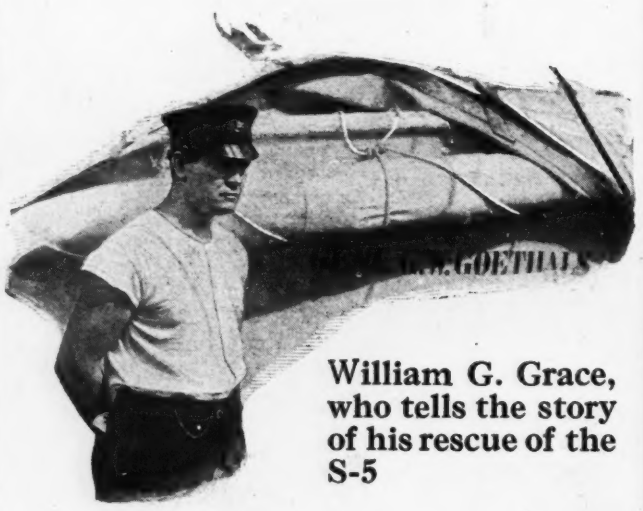
An Inverted Submarine

Inclined at an angle between 60 and 80 degrees was the unmistakable body of a submarine, stern skyward! As we came closer, a voice called through a megaphone across the water from the *Alanthus*, the ship that was standing by the submarine:

"There are forty men imprisoned in this submarine. Come help get them out. They've been in there thirty-seven hours already and can't hold out much longer. Bring what tools you will need. We haven't got anything but a hammer."

We were about thirty miles off the Delaware breakwater, and the sea was calm, though there was the usual ground-swell always to be found on the open water, no matter in what part of the world one may be voyaging. The propeller rods and screws of the submarine were high and dry. The captain of the *Alanthus* had leashed one of the rods to his ship in case the sunken boat should slip from her present position. A rope was fastened entirely around the body of the sub, and to this was tied a plank, which made a kind of scaffold upon which the engineer of the *Alanthus* had been working.

As soon as we realized the situation, Assistant Engineer McWilliams and I snatched up the tools we thought would be required. We took several chisels, a steel hand-drill, and an "old man." This is just a pet name for the drill-post necessary to press the point of the drill firmly down upon the hard steel plate. An electric hand-drill without a feed screw would have been useless; we should not have had the strength to press it down upon this tough steel to cut the holes. McWilliams and I climbed down a ladder from the bow of the *Alanthus* and took our place on the slanting plank. The rise and fall of the swell made of our scaffold a very unstable place, but it had to do.



William G. Grace, who tells the story of his rescue of the S-5

Chief Engineer William G. Grace, of the *General G. W. Goethals,* has given the Popular Science Monthly a graphic account of the part he and his assistant, R. McWilliams, took in the rescue of the crew of the S-5.

The Secretary of the Navy has presented a gold watch to Captain E. A. Johnson, master of the *Alanthus,* the first ship to reach the disabled submarine. Chief Engineer C. Jacobson and Chief Engineer Grace will also receive a gold watch, while Captain E. O. Simson and Assistant Engineer McWilliams are to receive binoculars.

It was a man's job to drill through tough steel the number of holes necessary to make an opening eleven by fourteen inches. Engineer Grace worked with his assistant for eight hours. At about two o'clock in the morning the chisel had cut the space between the last of the holes.

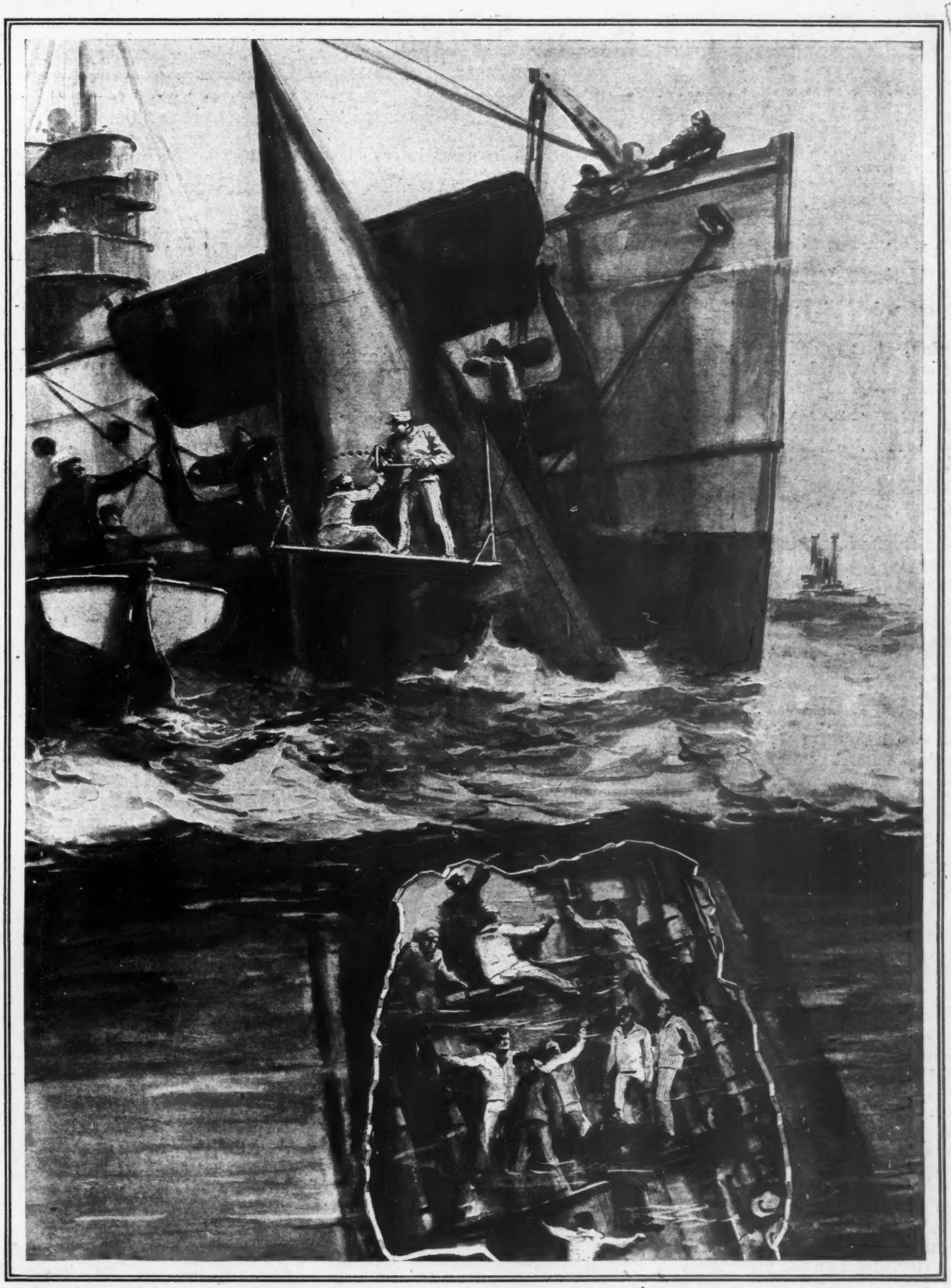
How the Submarine Sank

Right here I shall stop to tell how the submarine happened to be in such a fix. It was about fifty-five miles off Cape Henlopen when Lieutenant-Commander Cooke gave the order for a "crash dive." This is a maneuver that follows a long, swift run on the surface, and is merely a practice in quick submerging. It had been successfully tried the day before, but this time it promised to break all records.

Every man was at his place, the hatches were closed, and the air ballast was forced out as the water rushed in through the water doors. The submarine no sooner began to sink than something was found to be wrong—the bow was settling faster than the stern.

A quick inspection soon disclosed the terrible fact that one of the ventilators had refused to close and that the water was flooding the forward living spaces.

Every effort to close the air-intake valve failed, and the bow of the



How They Saved the Trapped Crew of the S-5

When the S-5 went down, her bow struck the bottom at a depth of 155 feet, and her crew was forced to take refuge in the cramped quarters far up in the stern of the boat. Here they were imprisoned until Engineer William G. Grace, of the steamship *General G. W. Goethals*, succeeded in drilling holes to make an oval opening eleven by fourteen inches in diameter in the stern.

The gasoline vapors and chlorine-tainted air poured out of the holes, almost stifling the men as they worked in the open air. A small hose connected with a pump on board the *Alanthus* was run through the small opening that the imprisoned crew had at first succeeded in drilling, but the amount of fresh air it was able to supply was insufficient. The imprisoned seamen were then hoisted to the deck of the *Alanthus*

s struck bottom at a depth of about hundred and sixty-five feet.

Water had rushed into the torpedo-room at the forward end of the boat, completely flooding it. In the control-room at the center of the boat, and also in the motor-rooms, there was water. Something had to be done, and that quickly. Finally the mischief-making ventilator was closed, and an effort was made to start the air-salvage system. The water had reached the storage batteries, and not only had it put the pumps out of commission, but deadly chlorine gas was being generated. The men were choking with the bad air and fumes, though most of them had donned gas-masks. The lights had been extinguished with the flooding of the batteries.

The submarine, being flooded in the forward compartments, was tilted bow downward at a sharp angle. The commander figured that, the depth of the water being one hundred and sixty-five feet and the length of the boat more than two hundred feet, the stern must be practically above the surface. Here lay the best chance of rescue. The boat itself was acting like a long buoy, marking above the sea's surface the place where it had sunk.

Trying to Drill to Daylight

The gradual increase in the chlorine drove the members of the crew toward the stern of the boat. They sealed the bulkhead of the compartment into which they were crowded—forty men breathing the same foul air, smothered in total darkness, choking with the fumes of gasoline and chlorine! There was just room for one man to stand above the others in the narrow space at the stern of the boat, and here it was decided to attempt to drill through to daylight.

The blast of foul air that came from those holes nearly overcame us as we worked. The odor of gasoline vapor indicated that it would have been unsafe to have used an acetylene torch to cut through the steel, even if we had possessed one. Mixed with the hot gasoline vapors was the occasional irritating whiff of chlorine, for some of this deadly gas was still leaking into the engine-room, where the men were standing on the bulkhead partition. Two hundred feet, or thereabouts, of the long boat was below them slanting downward, water-filled, and resting on the hard sandy bottom of the sea. The temperature inside of the compartment, even when the holes were admitting a small amount of fresh air, must have been close to 110° F.

Although quickly exhausted, working in darkness in foul air, by relieving each other at frequent intervals the men succeeded in drilling a row of holes five eighths of an inch in diameter along a line seven inches in length. For weary hours they worked, and then the drill was damaged beyond further possibility of use. Through this small aperture the crew succeeded in poking a rod at the end of which they had fastened a bit of cloth, and with this they tried to signal a ship that they could see through their peephole. Their spirits sank when it passed without seeing them.

The "Alanthus" to the Rescue

At last, after being in their terrible predicament all night, the steamship *Alanthus* caught sight of them and came to the rescue. But the *Alanthus* had no tools aboard except a heavy sledge-hammer, and with this the engineer of the *Alanthus* succeeded in denting inward the strip that the men had drilled in the thick steel plate.

Through the hole was run a hose attached to one of the ship's pumps, and an effort was made to pump air into the compartment, Not much air could they get by this crude device—but they imagined they were getting it, and that, strange though it may seem, helped them.

This is how I found them when McWilliams and I crouched upon the plank, trying to cut into the tough steel with a diamond-point chisel. It did not make a perceptible impression in the steel, which to me seemed the toughest material I had ever encountered.

A little later, by holding the drill with all my strength against the side of the plate, I managed to drill through, making a hole large enough to get a bolthead fixed to hold the base of the drill-post.

With the radius permitted by the arm of the drill-post I was able to bore a number of other holes, changing the position of the "old man" as the limit of the swinging arm was reached.

We Break Through

Working hard and persistently from sunset until about 11 P. M., I succeeded in getting two thirds of the holes necessary to complete an oval fourteen by eleven inches.

This was the size of the opening that would be large enough to let even a large man get through. By two o'clock in the morning the sledge-hammer and chisel had completed the task, and the plate was actually removed.

The groans of the nearly stifled men, the sounds of their vomiting, and the outrush of putrid air, all inspired us to work like mad. With the removal of the plate, the actual work of rescue began.

One by one, the half dead, stupefied seamen were drawn out of their torture-chamber. One by one, they were hoisted in a canvas sack to the deck of the *Alanthus*.

But for the clear-headedness and courage of the crew of the submarine, not one but many of the imprisoned forty would have perished. They have only their coolness and the intrepid guidance of Lieutenant-Commander Cooke to thank for even a possibility of their rescue. To Captain E. A. Johnson, master of the *Alanthus*, and Captain E. O. Simson, of the *General G. W. Goethals*, as well as to my assistant, R. McWilliams, they owe their good fortune fully as much as to my own effort.

Could It Have Been Avoided?

Could an automatic device have prevented the S-5 from submerging with her ventilators open? Down went the submarine in a "crash dive." But the outboard air-valve from the control-room was open, and the water rushed quickly into the ventilating system, finding its way through the induction valves and flooding the torpedo-room and forward living quarters.

A device that would make it impossible for a submarine to submerge with any of her ventilators open would be the best way to prevent future accidents of this kind. Various devices have been tried without success. The best alternative is to see that all the ventilators are closed before the boat submerges.

Here Are Some New Jobs for the Automobile Jack

This man did not possess a vise. So he made one by adjusting a jack and a block of wood in a doorway

Stoves are heavy, but not too heavy for an automobile jack to lift. Next time you have to scrub the kitchen floor, jack up the legs of your stove and make a good job of your cleaning

Window stuck? Take two thin boards and a jack; adjust them to position shown here and work the handle

New York's Machine-Gun for Mobs

By Captain E. C. Crossman

A NEAT little gun, weighing only seven pounds altogether and measuring two feet in length, is the latest acquisition of New York's police department. The little terror spouts forth huge .45-caliber bullets at the rate of fifteen hundred a minute as long as the magazine holds out.

With its high rate of fire,—higher than that of the fastest of speeded-up machine-guns used on airplanes,—its small size, and the ease with which its fire can be controlled, the "submachine gun," as its inventors call it, is without doubt the most formidable firearm in existence.

The gun, as made for use in America, fires the caliber .45 automatic army pistol cartridge. The bullet, nearly a half inch in diameter, weighs 230 grains, or eighty grains more than the bullet of the service rifle, and is nearly double the weight of the bullets commonly used by the police in their revolvers and pistols. The velocity of the bullet is low, and the extreme range when the gun is pointed at a 23° angle is only fourteen hundred yards, but it is far more efficient than the service rifle bullet at the moderate ranges of one or two blocks at which rioting would take place. The recoil is low, and in spite of the light weight of the gun, it is very easily controlled.

The ammunition is fed to the gun either by a flat box magazine holding twenty shots and projecting below the line of the gun, by a disk magazine holding fifty shots, or by the same type holding one hundred shots. The fire is controlled by the trigger. One shot can be fired by pressing the trigger and quickly releasing it, or the entire magazine may be discharged, or any number of bullets in between.

The gun may be furnished with a stock and fired from the shoulder, but in its form for use on mobs or other "spray" work it has only two grips, one for the right, the other for the left hand, and it is fired from the level of the waist.

The writer has fired one a number of hundred rounds, and, with considerable experience with the two types of weapon, finds the little submachine gun much easier to control in firing than the better known heavier sixteen-pound "light" Browning automatic rifle used by our troops in France. At from fifty to one hundred yards it is no trouble for one at all accustomed to the gun to riddle a man, while the entire front of a mob could be swept away from one curb to the other by a single burst.

The "submachine gun," recently adopted by the New York police department, spouts bullets at the rate of fifteen hundred a minute; one shot would riddle an escaping automobile

The gun has only a dozen parts, astonishingly simple when compared with the simplest of Browning's automatic rifles. Any tyro can take it apart for cleaning and repairs without the use of a tool.

The greatest effect of the gun with mobs would be through its moral suasion. When it is fired there is simply a roll of shots, a veritable roar, beside which the machine-gun with its five or six hundred shots a minute sounds as slow as a minute-gun. The empty cases fly in an unbroken stream from the ejection port. One burst over the heads of a mob not too ugly, and therefore not deserving of sudden death, would result in its instant and speedy dissolution. Fired at an escaping automobile, at which the popping of the average policeman's revolver is as effective as a bean-blower, it would riddle the car and those within it.

The gun was invented by Commander Blish, of the United States Navy, and General John T. Thompson, retired, formerly Assistant Chief of Ordnance of the Army, and during the war chief of the Small Arms Division, which gave to the Army the millions of resigned British rifles, known as our Model 1917.

Twins, Triplets, Quadruplets—Why?

Heredity, which plays a very important part in our lives, also affects our birth

HAS environment or heredity the controlling interest in the lives of twins? Let us consider twins in general. There are two kinds—identical twins and fraternal twins. Identical twins come from one single cell, which in the process of development happened to break in two and continued to develop in two separate halves. Fraternal twins, on the contrary, come from two distinct, unrelated cells that for some reason began to develop at the same time.

Identical twins are very much alike. They come from the same tiny parent cell, which so marvelously contains characteristics and traits of both the father and mother. Investigation shows that identical twins are not only alike physically, but that they are also alike physiologically and mentally. They often care for the same foods, like the same people, get the same diseases, even though living in different places, have similar handwriting, similar tastes, hobbies, and abilities. The identical twins pictured on these pages all tell the same story. Some of them have been living in different environments all their lives, yet they feel, think, and act alike. Heredity wins out.

Fraternal twins, who develop from unrelated parent cells, are not necessarily alike. Each one inherits the particular family traits with which his original cell was endowed. They may be of different sex, different complexion, character, size. Once more heredity and not environment scores.

Is twinning inherited? Is a woman who is a twin more apt to give birth to twins than a woman in whose family no twins have occurred? Statistics show that twinning is apt to recur in certain families. In some families the proportion rises to twenty per cent. It is certain that twinning is not accidental, but depends on certain constitutional factors of the parents.

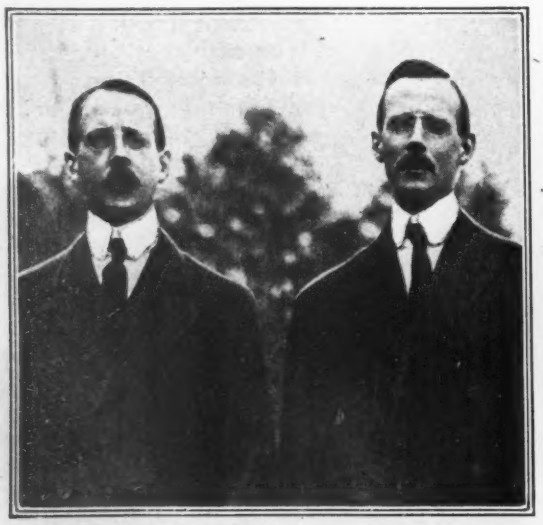
Occasionally triplets are born, and there are on record cases of four, five, and even six children at a birth. But it is very rare that more than three survive. Even in the case of triplets, one or two of them is very apt to be frail and frequently does not survive.

The higher the form of animal life, the smaller the number of young at birth. Certain species of fish lay thousands of eggs at a time. Rats, mice, cats, dogs, rabbits, and guinea-pigs are prolific breeders, producing from three to twelve offspring at a birth. Sheep, cows, horses, and

The oranges and the girls are twins—all from California. The only difference we can see between the girls is that one shows a little more of her teeth than the other. They recently entered a beauty contest

You might almost think this a freak photograph showing the same person twice, so alike are these twin brothers. The one on our left is the Rev. Edwin C. Brown, a Congregational minister

His brother's name is Edgar, and he is a bookkeeper. Both were born with defective eyesight—one in the left eye and the other in the right. They walk alike, have similar tastes and body weaknesses



These are the Grosvenor twins. They divided the highest honors at Amherst. One of them is the builder and director of the National Geographic Society and the other is an assistant attorney-general

Mrs. Vera De Mott, of Battle Creek, Michigan, and her twin. Which is which we do not know. Though living apart since they were three years old, their characteristics have remained similar

elephants, however, seldom have more than one offspring. It is a case of quantity *versus* quality. Single offspring are usually much further developed than individuals in a large litter. The young of mice and rats are without any hairy covering, whereas the lamb, calf, and foal are covered with hair. Their eyes are open and they are able to walk. Kittens and pups are hairy at birth, but they cannot see nor walk.

In most species the number of young in a litter is indeterminate. The Texas armadillo, however, is fairly constant in the matter—producing four young at a birth. They are "identical" quadruplets, all coming from the same original cell. Man and the armadillo are practically the only animals that give birth to "identical" groups.

Thorndike, the well known psychologist, says that you can't definitely tell by looking at a pair of twins whether they are identical or fraternal. Fraternal twins often resemble each other very closely. But at birth the difference is plain. Identical twins are surrounded by a common vascular envelope; fraternal twins have separate envelopes.

Robert and Frank Michel, five-year-old boys, are so much alike that their mother often washes one of them twice and lets the other go unwashed. They are so attached to each other that they are actually unhappy when separated. They become hungry and sleepy at the same time. Both of them are clever acrobats and work for the movies side by side.

The Ploger brothers, of Owosso, Michigan, look alike, weigh the same, have identical voices, similar tastes for operatic music, but differ in their taste for mathematics. Thus one is a machinist and the other a commercial man.

Rose and Louise Briot lived together for the first eighteen years of their lives, needing no other chums. Since then their lives have varied greatly. One is a widow and lives in the West near her children and grandchildren. The other lives in Chicago and has no children. In spite of their different environments, they remain very much alike. As girls they often voiced each other's thoughts, and now their letters cross repeatedly.

Decidedly different are the Cooper twins, who live in Newark, New Jersey. They are four years old, and yet one of them is twice as large as the other. The larger boy has long, thick hair that needs the attention of a barber. His brother still has a baby-like fuzz on his head.

The American Genetic Association is making an effort to secure greater knowledge of twins by actually studying them. More than six hundred twins have generously offered themselves for the purpose, and the results are most interesting.

Each pair of twins has a tale to tell and many of them furnish valuable physiological information.

George and John Seiffert, of York, Pennsylvania, are "identical" twins. Thus their heredity is the same; that they look alike is readily seen. They are eighteen years old, and thus far along in their history their likes and dislikes on almost every subject have showed no signs of difference

Making the Railroad Crossing Safe

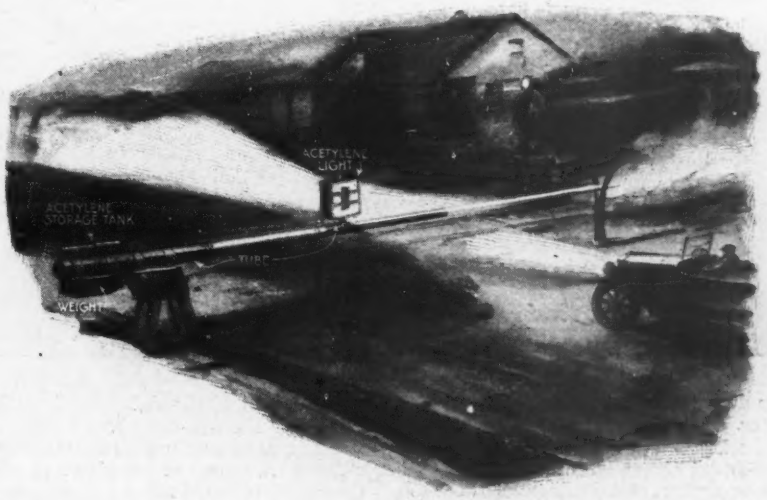
GRADE crossings of railway lines and automobile roads are dangerous enough in daytime and clear weather, but at night and in foggy weather the customary means of protection (bars and light signals) are often insufficient to prevent serious accidents caused by human carelessness.

The bar-and-light signal of warning shown in the illustration has been tried with success in Germany. The bar consists of a light metal tube long enough to reach across the road. It is painted in contrasting colors to attract attention.

The bar is hinged to a post at one side of the road and when not in use is in a vertical position. When a railway train is approaching, the bar is tilted to a horizontal position until its free end rests in the fork of the post on the opposite side of the road. In daytime, if the air is clear, the conspicuously painted bar will give sufficient warning to automobilists to prevent accidents.

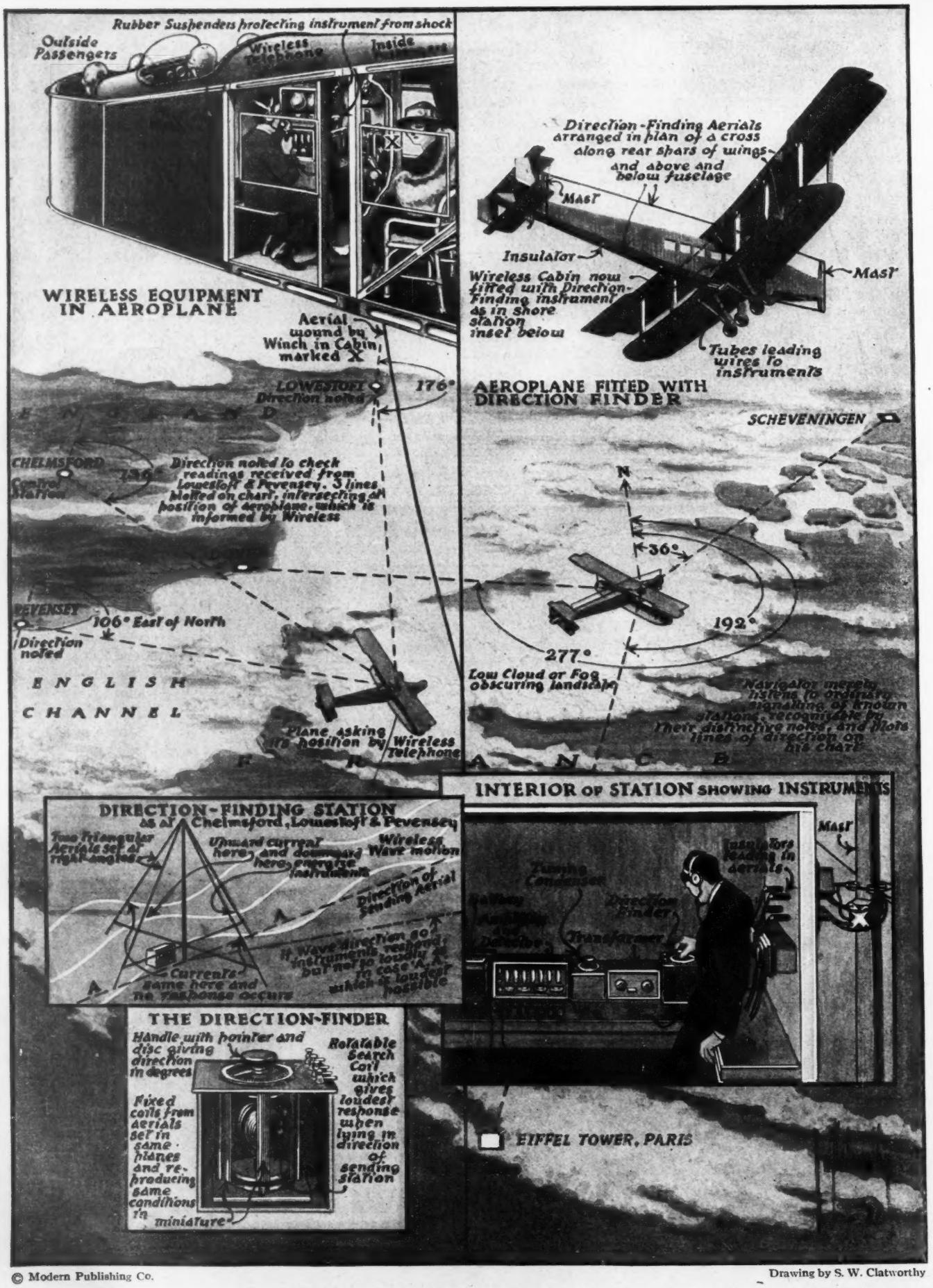
The light signal, which is used at night or in foggy weather, consists of a square lantern securely clamped to the middle of the bar. A powerful acetylene light within the lantern illuminates the two glass faces of the lantern, and displays in strong contrast the crossing symbol in dark outline, as shown in the picture.

The burner of the lantern is connected by means of a small-gage slender tube with the steel tank in which the gas supply under high pressure is kept. This tank, which holds enough acetylene for several days, is attached to the end of the tube, together with the counterweight and a device which controls the flow of gas to the burner. When the bar is not in use and therefore in a vertical position, only enough acetylene is supplied to feed the small pilot flame in the lantern. When the bar is lowered, the gas valve to the illuminating burner is automatically opened, the gas enters the burner and is ignited by the pilot flame.



In the daytime the bright colors of the bar warn the traveler of danger, and at night the brilliant light serves the same purpose

Wireless Guides the Aviator through Fogs


Rubber Suspenders protecting instrument from shock
Outside Passengers
Wireless Telephone
Inside
WIRELESS EQUIPMENT IN AEROPLANE
Aerial wound by Winch in Cabin marked X
LOWESTOFT
Direction noted
176°
ENGLAND
CHELMSFORD
Control Station
136°
Direction noted to check readings received from Lowestoft & Pevensey. 3 lines plotted on chart, intersecting at position of aeroplane, which is informed by Wireless
PEVENSEY
106° East of North
Direction noted
ENGLISH CHANNEL
Plane asking its position by Wireless Telephone
FRANCE
Direction-Finding Aerials arranged in plan of a cross along rear spars of wings and above and below fuselage
Mast
Insulator
Wireless Cabin now fitted with Direction-Finding instrument as in shore station inset below
Mast
Tubes leading wires to instruments
AEROPLANE FITTED WITH DIRECTION FINDER
SCHEVENINGEN
N
36°
192°
277°
Low Cloud or Fog obscuring landscape
Navigator merely listens to ordinary signalling of known stations, recognizable by their distinctive notes, and plots lines of direction on his chart
ANGLE B
DIRECTION-FINDING STATION
as at Chelmsford, Lowestoft & Pevensey
Two Triangular Aerials set at right angles
Upward current here, and downward here, energize instruments
Wireless Wave motion
Direction of Sending Aerial
Currents same here and no response occurs
If wave direction so instruments respond but not so loudly as in case 'A' which is loudest possible
THE DIRECTION-FINDER
Handle with pointer and disc giving direction in degrees
Rotatable Search Coil which gives loudest response when lying in direction of sending station
Fixed coils from aerials set in same planes and reproducing same conditions in miniature
INTERIOR OF STATION SHOWING INSTRUMENTS
Mast
Insulators leading in aerials
Tuning Condenser
Direction Finder
Transformer
EIFFEL TOWER, PARIS

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Drawing by S. W. Clatworthy

When an aviator flies above a fog-hidden or cloud-hidden landscape, the matter of landing becomes hazardous. How is he to find himself?

The radio direction-finder comes to his rescue. There are two methods of applying this remarkable wireless device. On the left-hand side of the above picture is seen an airplane asking its position from two ground stations which are in communication with each other and the machine. The angle and intensity of the wireless received from the airplane establishes its distance and direction from each station. A brief calculation enables them then to inform the aviator where he is.

The second method (illustrated by the airplane near the right-hand center of the above picture) shows the aviator determining his position by his own calculations. His instruments tell him the direction from which the ground signals come. This is accomplished by three loop-aerials, one mounted fore, another aft, and the third crosswise along the wings of the airplane. Two ground stations are sending continuous but different signals, easily distinguished

Wireless as an Aid to the Airplane

By John Stuart

WERE you ever lost in an airplane, at sea, in a forest, or on the streets of a strange city? If so, you know there are just two ways of finding out where you are. One is to figure it out for yourself by noting the direction of two landmarks, and the other is to ask somebody else to tell you. Before the days of radio you could find out only if you could see the two landmarks or be seen from them, unless you were within calling distance. Now it can be done in a fog or above the clouds. The pictures on the opposite page show how airplanes may use either method. The airplane on the right-hand side illustrates the first method of figuring it out for yourself, and that on the left shows the second method.

Both Depend on Radio

Both methods depend upon a phenomenon of radio receiving. If one uses a loop of wire as an antenna for receiving, he will find that when the plane of the loop points toward the station that is signaling, the signals are best received. When the loop is at right angles to this direction no signals can be heard. For all positions between these two the signals may be heard, and they get stronger as the loop is turned away from the right-angle position.

In the right-angle position both vertical wires are equally distant from the signaling station and are always affected alike. If the current induced in one vertical by the ether wave is up, that in the other will also be up. The currents in the verticals then neutralize each other, leaving no current in the loop to affect the detector of the radio receiver. This is shown by the middle picture on the left.

This picture of a direction-finding station shows two fixed triangular loops instead of one that can be rotated. The currents from these loops pass through two small coils in the box shown immediately below. These coils are set at right angles, like the loops. There is also in the box a third coil which may be rotated. In it the currents in the two fixed coils induce a current. This induced current is then led to the detector. The movable coil, under these conditions, acts just like a single loop antenna and so gives an indication of direction.

In the first method for navigating an airplane, the radio operator calls two land stations and asks them to tell him where he is. Each of these finds on his position with a direction-finder and reports his angular position. The upper picture on the left side shows how the radio stations in England operate to locate an inquiring airplane. From the two directions the position of the airplane is known and its operator may be informed.

The Direction-Finder as a Compass

The other method has recently been demonstrated in England by the Marconi Company. It is illustrated by the picture on the right side of the page. The radio operator on the airplane finds his own position by observing his direction from two fixed land stations, which are always transmitting but sending different signals, so that they may be distinguished easily. The loops are mounted, one fore and aft and the other crosswise along the wings of the airplane. The coil-box used on the airplane is of the same type as that for land stations. By plotting his direction from the two stations the airplane operator finds where he is. He may also use his direction-finder as a sort of compass and maintain his flight in any direction.

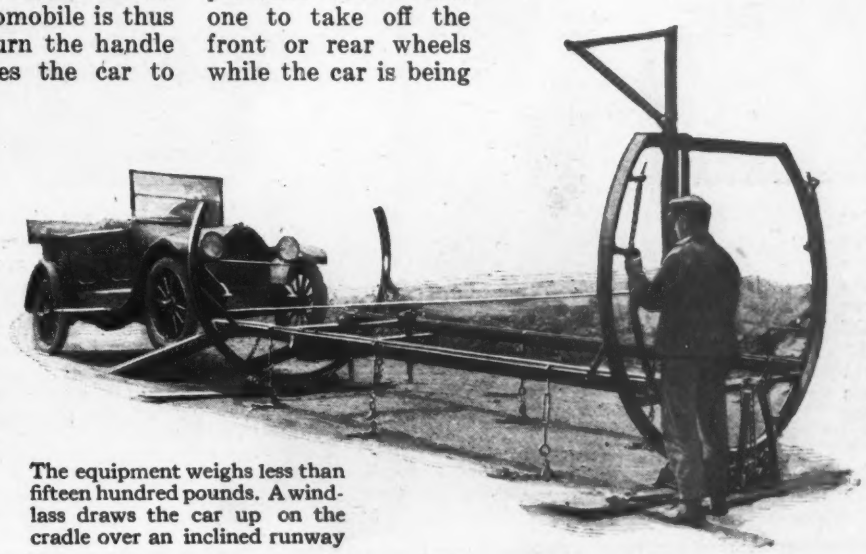
Turn Your Car Over with One Hand

Working on automobiles in comfort means better repairing

NO longer is it necessary to get out and crawl under the automobile to repair it. With one hand you can turn your automobile over! Here is a device that has a track and a small windlass to pull the automobile from the floor to the track. It is equipped with simple appliances to hold the machine so firmly that when it is overturned there will be no strain on the chassis. When the automobile is thus in place, a child can turn the handle of a crank that causes the car to rotate at any desired angle. What a relief to see the workings on the underneath part of one's automobile without having to lie flat on one's back on the floor!

An inclined runway, or skids, lead from the floor to the longitudinal tracks forming the base of the cradle, which may be placed anywhere without being braced or anchored to the ground. A small windlass draws the car up on the cradle, and there is a small crane that can be used to lift out the engine when necessary. The entire equipment weighs less than fifteen hundred pounds; it is made of "knock-down" parts that can be quickly and easily assembled.

Special jacks are provided that enable one to take off the front or rear wheels while the car is being rotated. The repairman, instead of lying on his back under the car, sits down and comfortably reaches the parts that require his attention. It is a scientific fact that a person in a comfortable position is more efficient in any work than when he is straining physically while working. It is estimated that at least four times more work can be done in a given time by making use of the device that turns the automobile over.



The equipment weighs less than fifteen hundred pounds. A windlass draws the car up on the cradle over an inclined runway

The man who works in a garage finds in this new device a preventive of many unnecessary aches and pains.

It is almost unnecessary to observe that liability to accident is considerably reduced owing to the careful inspection made possible by the use of this adjustable automobile rack.

How Furs Are Made into Garments

They're hard to sew and hard to clean

Preparing animals' skins and manufacturing them into fur coats and muffs and neckpieces has grown into a huge industry requiring a high order of skilled workmanship. The padding and lining of a garment must be sewed to the skin, and the stitches must not show on the outside. How is it done? A special sewing-machine needle is used that pierces the skin only half way

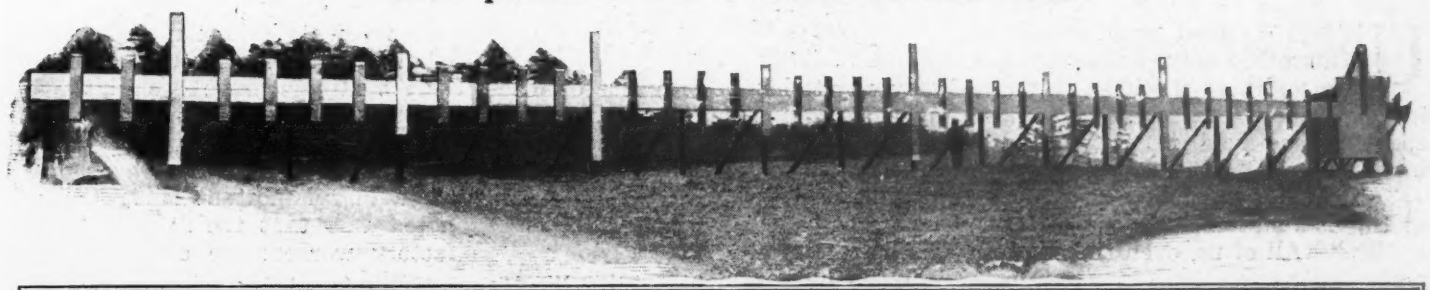
When your coat gets that worn, scraggly look, you take it to a furrier to have it "glazed." What does he do? Scrubs your coat with water and a stiff scrubbing-brush; and when it dries, it is soft and smooth. Of course, it's all in the way he scrubs

Shaping a fur collar is not so easy as it may appear to be. The collar has to be stretched into shape. This is done by nailing it to a board, where it is left for several days

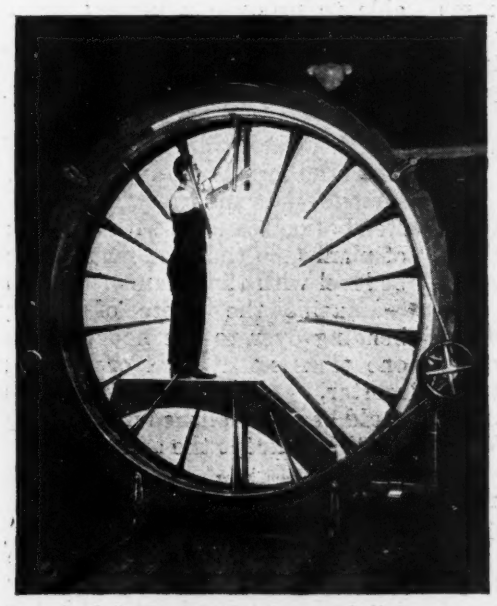
Furs are cleaned by the use of sawdust and sand. Above you see a furrier putting a handful of sand in a large revolving drum. Then he will put in the muff, close the drum, and turn on the switch. The fine grains are forced into the fur, removing the dirt

How the Big Searchlights Are Tested

Light is measured by a "photometer": these pictures show what it is and does

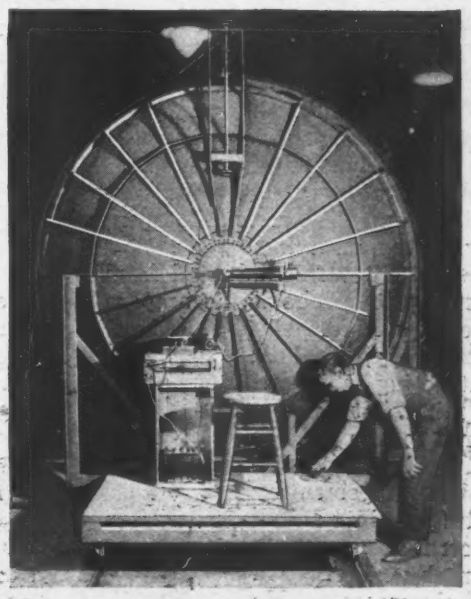


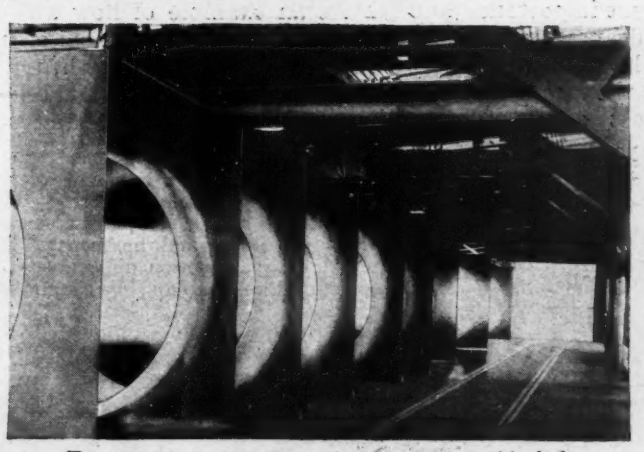
This huge scale measures the diameter of searchlight beams. It is located 2300 feet from the searchlights. The shed at the right houses a photometer



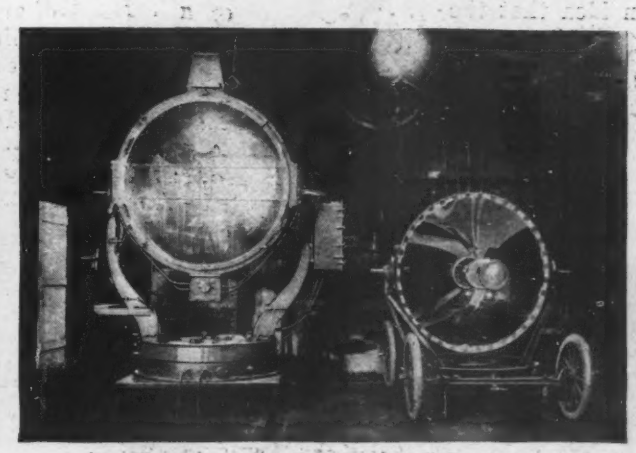
Left: The front of the integrator. It has a diameter of 110 inches and is provided with an iris shutter, which adjusts the opening to the diameter of the searchlight beam under test. The integrator is on wheels so that it can be moved easily

Right: The business side of the integrating photometer at Schenectady. A photometer measures the candlepower of light sources. The integrator is a reflector which collects the light and projects it into the photometer. The measuring unit of the photometer is at the center of the integrator, where the light from the searchlight under test is collected and its candlepower measured





Beams of light are directed through these big holes to cut off all the stray light. By "stray light" is meant light that is not part of the beam itself. If this light reached the integrator, it would be impossible to calculate the beam's actual candlepower



A military searchlight of the fortification type is shown at left. At the right is a sixty-inch portable army light. The air of the photometer room is kept as free from dust as possible by suction fans and air-filters. Dust interferes with results

The big lights out of doors for testing under actual operating conditions

The Man of the "One Best Way"

How Frank Gilbreth studies men and their ways

By Fred C. Kelly

UNTIL I talked with Frank B. Gilbreth, I never suspected that the ordinary motions we make in going about our every-day affairs could become a subject of fascinating interest.

"All human activity," says Gilbreth, "is a matter of motions and decisions." All of us, even the experts, make needless motions, or wrong motions. We suffer unnecessary fatigue because we don't perform our usual tasks in the One Best Way.

Finding the One Best Way

Frank B. Gilbreth is a consulting engineer. His specialty since 1911 has been scientific management. He probably knows more about human motions and the causes of fatigue than any other man living.

When Gilbreth graduated from the Boston public schools, he prepared to enter the Massachusetts Institute of Technology, intending to become a contracting engineer. But he changed his mind. It had occurred to him that he could learn more about management by getting out into actual construction work than by staying in the classroom. He had an idea that the only way to handle problems of management competently was to know a few of the trades with which he might have to deal. So he started in and learned twelve different trades before he called that part of his education complete.

When he began, as a mere youngster, to learn various trades, Gilbreth found that a big obstacle to his plan might be the time required to become proficient in each one. The only way to overcome this was to learn a trade more rapidly than the average apprentice could learn it. One of the first things he attempted to learn was to lay bricks.

Now, bricklaying is one of the oldest of trades—dating back two or three thousand years prior to the birth of Christ. There are even historical data on which to base a belief that bricklaying is at least seven thousand years old. And yet, as Gilbreth noted, in all those seven thousand years it had improved, as to method, scarcely at all.

Gilbreth studied the methods of various bricklayers—the poor workmen and the best ones, and he stumbled upon an astonishing fact of great importance and significance. He found that he could learn most from the *lazy man!*

Most of the chance improvements in human motions that eliminate unnecessary movement and reduce fatigue have been hit upon, Gilbreth thinks, by men who were lazy—so lazy that every needless step counted.

Another important thing Gilbreth noted was that the so-called expert factory workers are often the most wasteful of their motions and strength. Because of their energy and ability to work at high speed, such men may be able to produce a large quantity of good work, and thus qualify as experts, but they tire themselves out of all proportion to the amount of work done.

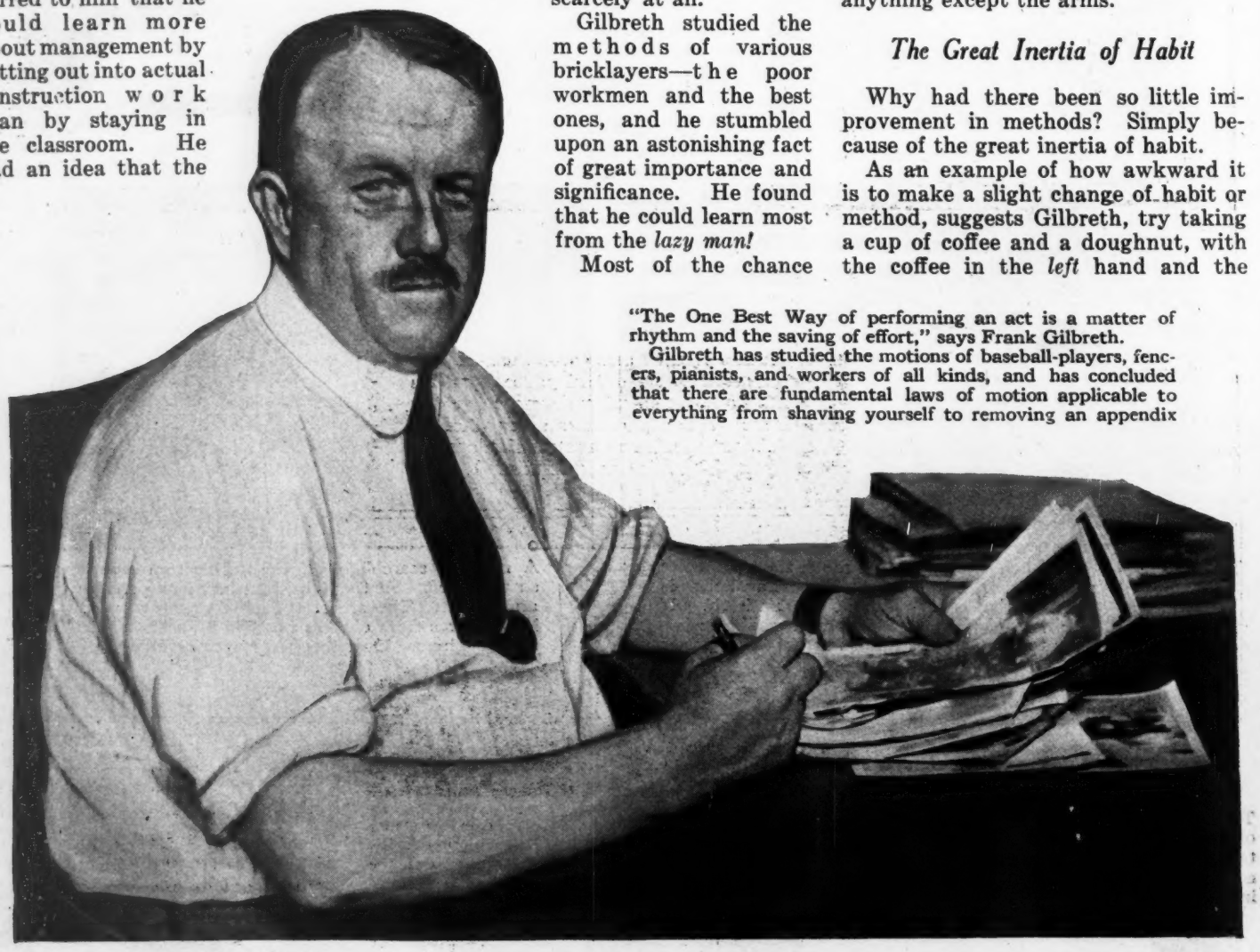
"Men were still working on scaffolds with the bricks and mortar on the same level as their feet," he says, "instead of on scaffolds with an extra row of planks, so that the materials could be level with their hands."

Imagine the waste of energy in bending over to the floor every time one picks up a brick or a trowel of mortar, when the entire operation could be accomplished without moving anything except the arms.

The Great Inertia of Habit

Why had there been so little improvement in methods? Simply because of the great inertia of habit.

As an example of how awkward it is to make a slight change of habit or method, suggests Gilbreth, try taking a cup of coffee and a doughnut, with the coffee in the *left* hand and the



"The One Best Way of performing an act is a matter of rhythm and the saving of effort," says Frank Gilbreth.

Gilbreth has studied the motions of baseball-players, fencers, pianists, and workers of all kinds, and has concluded that there are fundamental laws of motion applicable to everything from shaving yourself to removing an appendix

doughnut in the *right* hand. If you think such a revolutionary change in habit will not upset you a bit, just try it! Unless you're careful, you'll find yourself with your hands crossed and your brain in a whirl.

So, Gilbreth worked out an entirely new method of bricklaying, which makes it possible for a man to have bricks served to him at the level of his breast, to avoid the useless bending. A whole book could be written on just this subject of bricklaying and how Gilbreth revolutionized bricklaying practices.

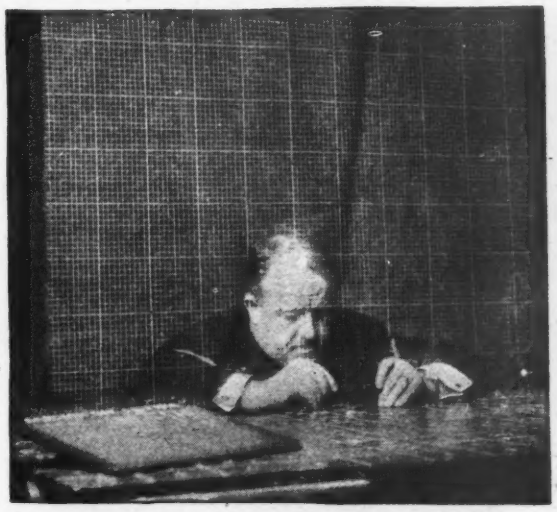
Gilbreth makes a motion-picture of a master mechanic, a handkerchief-folder, a tatter, a champion baseball batsman, or an expert fencer, for example. A specially contrived clock, the hands of which record time down to the millionth part of an hour, also appears in the picture to indicate the elapsing time, which is necessary because the crank of the camera or that of the projector cannot be turned at precisely the same rate. Gilbreth has only to study a film to tell you to the hundredth part of a second how long it took to make a motion.

The cyclegraph, on the other hand, consists simply of a small electric light fastened to an arm, a leg, or a head. On an ordinary photograph of a man so equipped streaks of light appear as his arm, leg, or head are moved—the path of the motion. The cyclegraph helps out the motion-picture machine; it reveals much that the machine cannot reveal. It synthesizes motions; the motion-picture machine merely analyzes motions.

After years of study, and by means of his moving-picture machine and the clock with split seconds, Gilbreth has learned that all speed champions, whether typists, bricklayers, oyster-openers, skilled wrappers of bundles in mail-order houses, or sealers of tin cans, have certain motions in common. They proceed from one motion to the next with the minimum of changes of direction. They have rhythm where an unskilled worker might have jerks. In short, every good motion is based on two factors: rhythm and economy of effort.

Gilbreth has learned the motions of skilled fencers, pianists, famous golf-players, surgeons, baseball-players, and others. And he found not only what motions different experts make, but precisely how much time each motion requires. In photographing different members of the New York baseball team, he learned, among other things, that the speed of a ball hurled at the batter by the pitcher varied from 210.07 feet a second, or two and two fifth miles a minute, to a velocity of two and four fifths miles a minute.

Scientific management, says Gilbreth, may be applied to one's every-day household affairs in scores of ways. Even in so simple a matter as getting dressed or undressed, there is a wrong way and a One Best Way.



To measure the distances of motions, Gilbreth uses many methods. This picture shows one of his penetrating screens erected in the plane of the edge of a high table. It passes through the arms and head of the man, in this case Mr. Gilbreth himself. Double exposure is responsible for the effect produced. The screen is carefully ruled, so that motions may be referred to it for exact measurements

"Few persons realize," maintains Gilbreth, "that clothes which are never pressed, but are properly folded, or hung up, each night, will look well longer than clothes which are pressed occasionally, but never folded or hung up."

Gilbreth has proved by actual demonstration that if a man's clothes are laid out in the order in which they are to be put on, he can dress himself in less than half the time it will take if he has to stop and hunt each article as it is needed. In other words, it is economical to hunt up "other" clothes all at once, when the mind is on such a search.

Nearly everybody, by the way, falls into definite habits about getting dressed and undressed. Most of us take off the same shoe first every night—and usually, for some reason, it is the left shoe. Watch yourself and see if this isn't true. We unconsciously follow a regular order in taking off our clothes. One man may take off his collar before removing his shoes, and another may do just the opposite. But the point is that he is almost certain to follow always the same sequence.

It is interesting to learn just how Gilbreth cut down his shaving and face-washing time from twelve minutes to two. In the first place, he discovered that he can shave more rapidly with one make of safety razor, but more closely with another. So he uses the first razor for "the first time over," and finishes off with the second model better adapted for close work. His most important time-saving method of all is the use of a brush in each hand for applying the lather. "Otherwise," he says, "your left hand is idle at your side. If it is employed in scratching your leg or in any useful purpose whatsoever, well and good; but if it is doing absolutely nothing, why not put it to work?"

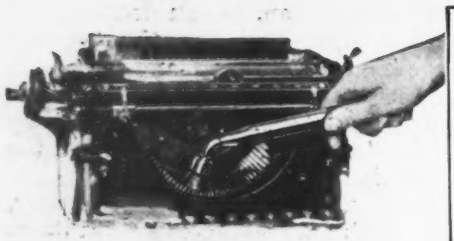
Now, Gilbreth doesn't take all this seriously except as an object lesson. He doesn't advocate a Save Shaving-Time Week, or anything like that. Still, the difference between twelve minutes and two in the morning is not to be sneezed at.

Little items like these do not matter much, of course, and they are mentioned here solely because they serve as examples of the effect of habit, and because they show how possible it is to conserve time even in the simplest every-day processes.

Right here somebody will exclaim: "Goodness sakes, how terrible it would be to live with a man like that—who even washes his face according to a system."

But the truth is that Gilbreth is no crank and he wouldn't be bad to live with. He is an easy-going, big fellow with twinkling eyes and a sense of humor, and his purpose in shaving and washing his face systematically is not to save time, but to learn something that he can use as an object lesson, in order to interest people in saving time where it is of genuine importance.

Gilbreth invented the cyclegraph in order to study human motions. An electric lamp is attached to the head, a shoulder, an arm, or a foot. It moves with the part to which it is attached. The motions are photographed. The streaks of light on the photographic plate, analyzed by Gilbreth's method, reveal just how the motions were performed. In this photograph the cyclegraph is applied to a typist



The Fountain Principle as Applied to a Brush

HERE'S a new fountain brush which feeds like a fountain pen.

It can be used for cleaning clothes, blacking and oiling shoes, blacking stoves, cleaning typewriters and typeforms, veneering furniture, and many other uses also fall within the scope of this serviceable fountain brush, the handle of which is filled with the polishing liquid.

To feed the brush, all that has to be done is to press it against some solid surface. This will release sufficient liquid to do the work.

When taken from the surface, the brush automatically goes back into normal position and the feed-valve closes.

Hitch Dobbin by His Own Right Leg

NO longer need the driver of a restive horse carry a heavy weight around with him to fasten to the bridle when he leaves his horse standing.

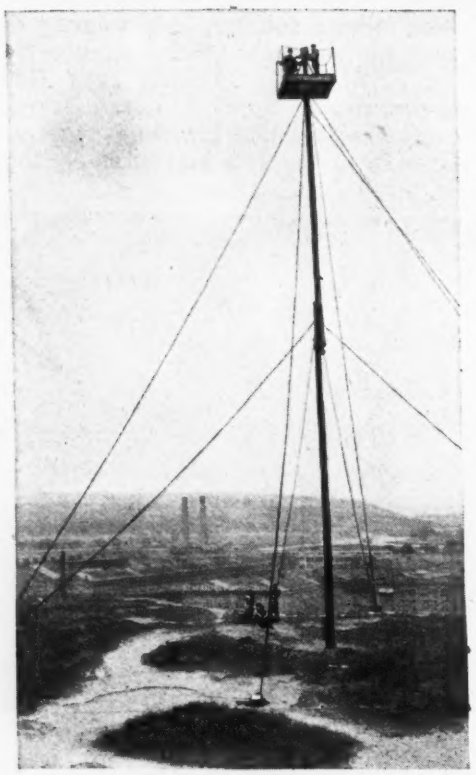
The photograph below shows a method of hitching which is both simple and effective.

A strap of the right length is attached to the shafts or tongue of the vehicle and is snapped to a shorter strap, which passes around one of the front legs of the horse. The horse is thus prevented from taking a step forward.

When not in use, the strap is thrown back into the front of the vehicle.

This invention does away with the old weight-and-bridle connection.

The usual way of hitching a horse requires either the use of a hitching-post or the cumbersome carrying of a hitching-weight. The new way dispenses with both, or, rather, with the weight, since this motor-driven age has banished the hitching-post almost entirely from the streets.

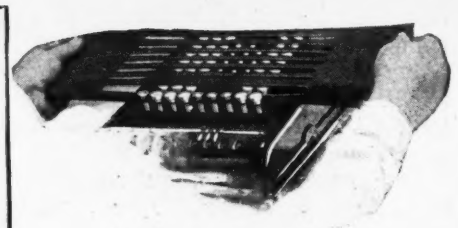


And All to Photograph a Factory from on High

SOMETIMES airplanes have been employed to fly over industrial plants to obtain suitable bird's-eye views; remarkable kites have been built to take a camera up over a factory for the purpose of getting the "whole thing" in the picture; but this is a tall tower erected to permit a photographer to mount his camera in such an elevated position that just the desired point of view of a certain group of manufacturing buildings can be pictured.

The company's riggers put up a simple structure which resembled the single mast of a ship.

Up to the "crow's nest" climbed the camera-man. Needless to say, there was a funny feeling in the pit of the photographer's stomach when he stood on top of his lofty perch, but it did not prevent him from obtaining a successful camera's-eye view of the immense works.



All the Keys Cleaned at One Fell Swoop

AN invention for cleaning the keys of a typewriter, adding-machine, and other forms of key-actuated machines, has been patented by James W. Pennewill, of Silver City, New Mexico.

It consists of a piece of heavy cloth cut lengthwise through the middle portion into eight strips, each about a half inch in width, and separated from each other by a space of about a quarter inch.

These flexible strips, arranged over the keys and drawn back and forth from side to side, will clean the tops of the keys.

To clean the flat rods under the keys the strips are twisted and inserted against the rods.

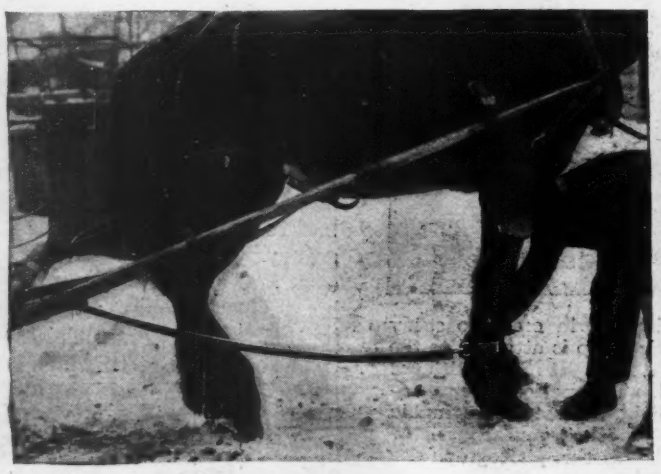
Riding a Bicycle Over a Railroad Track

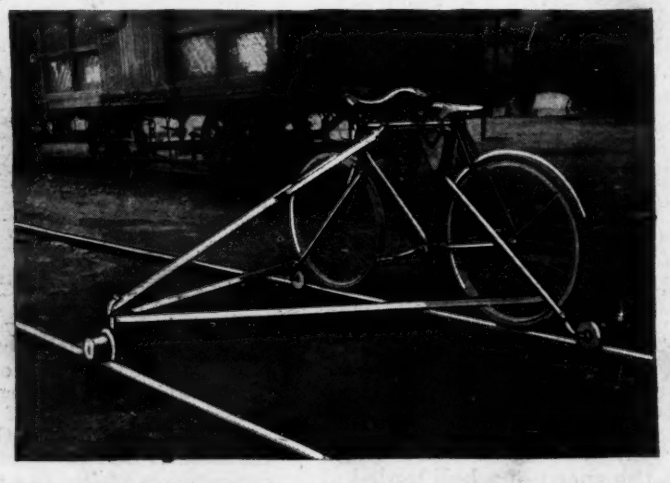
FRANCE has produced an ingenious inventor who decided to make use of the railroad-tracks when strikes put the trains out of commission.

With the aid of a specially contrived frame and three small wheels he has converted his bicycle into a vehicle that will run on the smooth steel rails, thus giving him the advantages of considerable speed and small expenditure of energy.

The surface of a metal rail offers less resistance than the surface of any but the finest road-surface. The additional weight of the frame and the small wheels must be taken into consideration, but to offset this the inventor has the advantage of a direct line which is graded perfectly. A railroad does not ordinarily twist and turn as much as a road, nor are its grades as frequent or as steep as those encountered in the ordinary country road.

Under normal conditions the law will not permit any one to make use of a railroad right of way.





Scraping Paint by Machine

AFTER a summer of hard rain the paint on most automobiles looks dull and dead; whereupon the owners often send them to the factory to be repainted. But, before a new coat of paint is baked on, the old one must be removed. Until recently this has been a long, tedious job.

Now there is a machine that will do it in an hour. A gritty paste is first smeared over the paint, and then the machine shown above is moved across it. There are two feet, or kickers, that move alternately backward and forward. They are actuated by compressed air.

A Dearth of Pullman Cars

IN the days of plenty, before the war, even Pullman cars were numerous. Between the years 1905 and 1915 there was an increase of seventy-six per cent in their number, with a smaller increase of forty-four per cent in the number of passengers carried.

But in the past five years the tale is very different. There has been a fifty-four per cent passenger increase and only a four per cent increase in the number of cars.

This state of things will explain, in some degree, the lack of accommodation on even the best equipped railroads.

Put the Wind to Work Generating Electric Power

MOST of our power is obtained from fuel today. But fuel—coal, gasoline, wood, alcohol—is becoming scarce. A French inventor has suggested that we return to the use of wind for motive power.

He has invented a new type of windmill for the purpose.

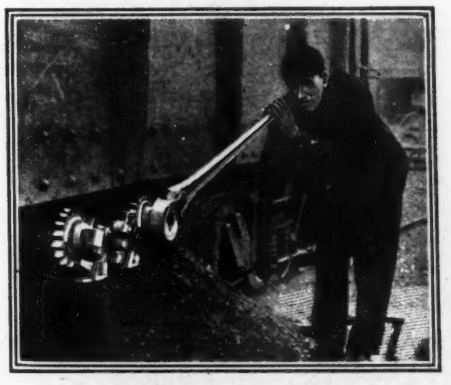
Instead of using vanes that radiate from a common center, he uses vertical ones in cylinder formation. They are set at such an angle that they will always catch the wind, no matter how gentle it may be. If the windmill has an electric generator attached to it, each time the vanes go round the armature will be turned and a storage battery charged. Thus on exceedingly windy days enough electricity will be generated and stored to make up for the small amount generated on days when there is little wind.

"Get Up!" Says the Record

"BREAKFAST is ready!" You grow very tired of saying that, year after year, to the various members of your family. Why not let the talking-machine say it for you?

There is now a clock that, instead of ringing an alarm bell when it is set, will release the phonograph lever. A special household record is now made. There are on it all the various sayings which you repeat every day: "Breakfast is ready"; "Hurry up—you'll be late," and so on.

When the clock releases the lever, the words of wisdom pour forth.



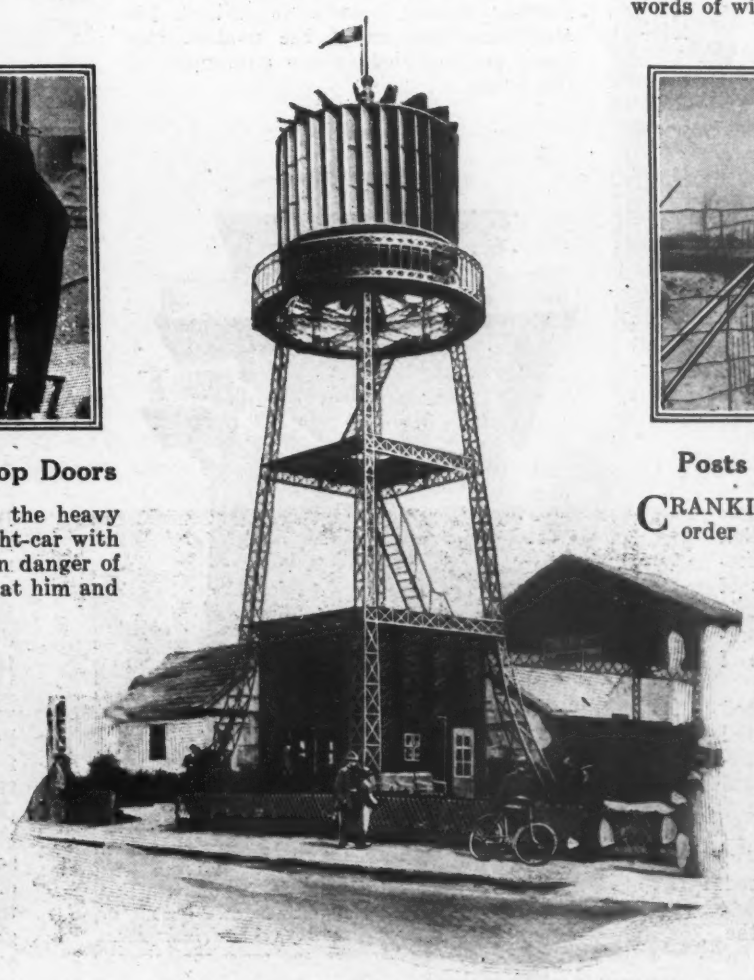
A Safety Wrench for Drop Doors

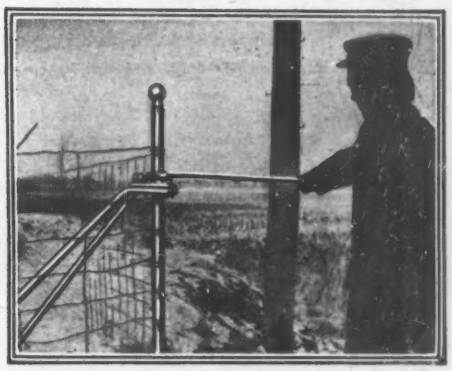
THE workman who releases the heavy drop-bottom door of a freight-car with an ordinary wrench is always in danger of having the wrench swing back at him and break his wrist.

But there is now a new wrench—shown above—in which this dangerous feature has been eliminated.

A ratchet and pawl inside the head of the wrench absorb all the motion. The socket itself is a part of the ratchet member.

This new wrench is made entirely of steel and has an average tensile strength of sixty-five thousand pounds.





Posts that Tighten Fences

CRANKING up is all that is needed in order to tighten wire fences when posts like the one above are used. Ten holes are drilled in the post and the fence wire is run through them. The post can turn, but it is held fast by means of a ratchet. Should the wire sag in the course of time, the post can be cranked up to the next notch at one jerk.

The posts are made both in iron and in concrete, and will last much longer than wooden posts. They may be spaced twenty feet apart and yet give the fence sufficient strength.

Shakespeare *vs.* Los Angeles

HUGE volumes weighing several hundred pounds each are here shown. They are filled with nothing but names. Names of what, you ask? Names of people who visit Los Angeles every year.

The Chamber of Commerce of that city claims that over five hundred thousand tourists visit their city every year.

The number of daily visitors ranges from one hundred to twelve hundred. Each of the big books contains the names of over a million persons on four hundred pages measuring twenty inches by two feet. The thickness of each volume is about fifteen inches.

And now that the fair city of Los Angeles has all of these names, what is it going to do with them?

Perhaps Los Angeles wishes to show her rival, San Francisco, the exact number of visitors to the more southern town. It is obvious that she does not share Shakespeare's scorn of a mere name.

An Old Water-Tower Becomes a Home

THIS man lives high, but he has defeated the high cost of renting. There was an old water-tower that had not been in use for years near the farm on which he lived.

He decided to buy the place and fix it up to live in. The picture shows what a good job he made of it.

Set in the center of a large flower-garden, with its picturesque stairway and ivy-vines, the tower looks like a little castle in some foreign land and very few people would guess right off that it is situated somewhere in New York state.

The platform around the top of the tower is used as a porch. Electric lights, running water, steam heat and all the other conveniences of the modern city home are included in the equipment of this house.

One Good Bath Deserves Another

IT is necessary to wade through this pool before you can walk up the stairs. People who bathe in the ocean always carry part of the beach with them into the bathing-house.

A Western bathhouse owner had trouble keeping his place clean, and he hit upon the idea of placing a small pool outside the door in which the bathhouse patrons could take a final wash before entering to dress. This helped to keep the place clean and also to keep the sand out of the patrons' clothes.

The cement pool is supplied with plenty of fresh water, and means are provided to keep the sand cleared from the bottom. All of the stairs leading into this modern bathhouse have a pool at the bottom.

This arrangement insures a clean bathhouse, free from the annoyance caused by the presence of sand on the floor and elsewhere. People leaving the place do not suffer from sand in their shoes, as is generally the case.

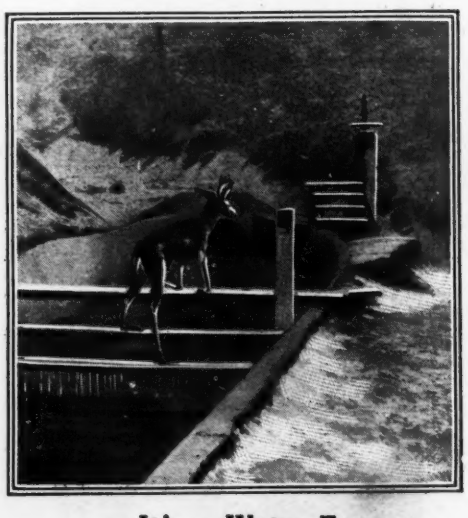
Illumination Makes Visible Some Comparisons

RECOURSE to illuminated graphs as a means of presenting its case to the public was taken by a Chicago electric-light company. On a big electric sign over the entrance to its office-building, the changes in cost of food and clothing, fuel, taxes, and electricity since 1896 are compared, to the great advantage of the last named commodity.

The cost of clothing and food from year to year is represented by the top line, which rises gradually until 1904, when it shoots upward.

Fuel and taxes, big factors in the cost of producing electricity, are also seen to have increased steadily.

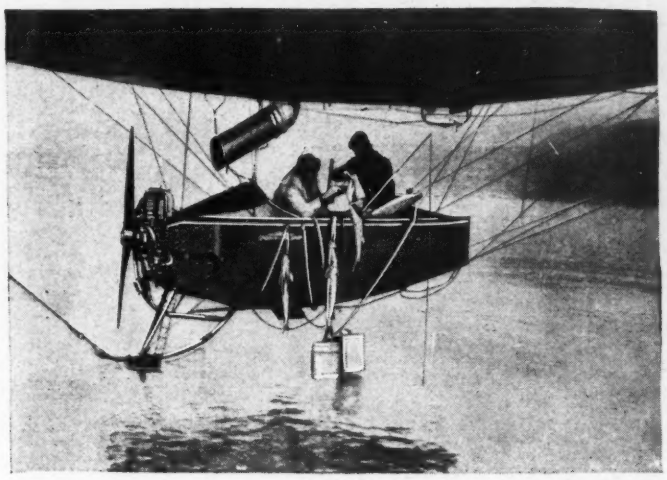
The cost of electricity to the consumer, however, has had a general downward trend.

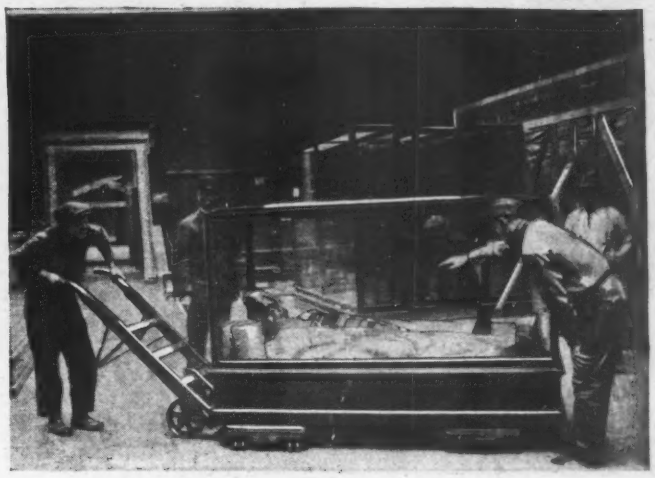


It's a Water-Escape Ladder Provided for Deer

AN operator at the power house of the Hetch-Hetchy water supply, in California had an opportunity not ordinarily afforded a photographer. He had his camera ready just at the right moment to catch a deer climbing up the ladder installed across the aqueduct which carries the water to the intake power house. Sure of his footing, the animal made his way carefully up the narrow boards, instinct preventing him from making the graceful leap that one might expect of a surprised deer.

This ladder is placed in position so that the deer that come to drink and by accident fall into the water, can escape. Struggling in the water, the animal soon finds that he can climb up on the steps.

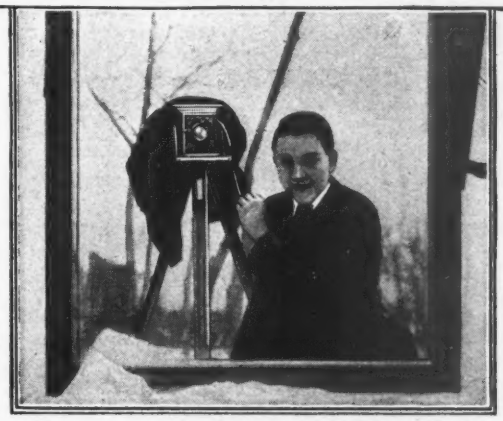




The Barracuda and the Blimp

WHY sit on board a ship and fish blindly for hours? Perhaps there are some fish in your vicinity and perhaps there are not. In a blimp, however, you are able to see into the water and you can spot a school of fish without any trouble.

Above you see some men blimp-fishing in San Pedro harbor, near San Diego, California. They were sailing at a height of forty feet when they sighted a school of barracuda. They stopped the engine, let the blimp drift, and, as fast as they could, hauled in the fish.



American Rivalry in Dyes

EVEN in the matter of dyes, American manufacturers are cutting in on German monopolies. Phthalic anhydride, an important dye intermediate, is now made in America by a new process which enables manufacturers to sell it for forty-five cents a pound; Germany charges seven dollars a pound.

Atmospheric air is used in making phthalic anhydride from naphthalene in our country; but the German method necessitates the use of sulphuric acid and mercury.

Bottle-Caps Do Their Bit

THE crown bottle-cap, used by home brewers, has a rough, corrugated edge that will cut into the hardest ice.

Nail a bottle-cap to the heel of each shoe, as shown below. When you reach your destination, you pull the cap off.

Photograph Yourself in a Mirror

GO outdoors and take your camera. Place a mirror with its back to the sun and stand in front of it. Focus the camera on your image and pull the trigger. You will then have taken a picture of yourself at your best. Of course the camera will show, too.

If you suffer from self-consciousness, no one will ever guess it when your picture is produced.

A Fish-Shaped Padlock

PADLOCKS are not exciting things to make, so it is not surprising that an English locksmith—for the sake of variety—made a padlock in the shape of a fish. The keyhole is located just below the gills, and the jaws do the locking. When the fish gets lockjaw, nothing will cure it but the proper key.

The locksmith who made the fish bears the name Chubb. So he simply copied a real chubb fish to make his lock.

Moving-Day for the Mummies

CHICAGO'S famous Field Museum is changing its locality. Dummies, dinosaurs, butterflies, and sea-dragons were carted away in box cars, motor-trucks, and wagons. A special track connecting the old museum with the main line of the railroad was constructed so that the heavier articles could be hauled away.

Although the moving was carried out in an orderly fashion, it presented a scene that looked like the wildest disorder. Mixed with the animals were Egyptian tombs, mineral collections, birds, fish, antiques, armor, and statues. Many of the more delicate objects had to be carefully crated so that no harm would befall them in transit.

Moving-day for a museum costs many thousand dollars.

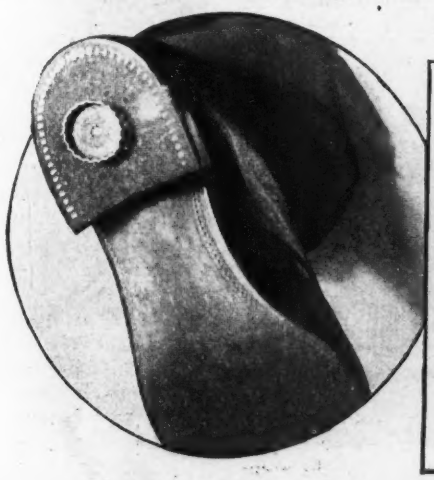
Imagine the surprise of a trainload of cows should they cross the path of some wonderful Greek statues or prehistoric creatures.

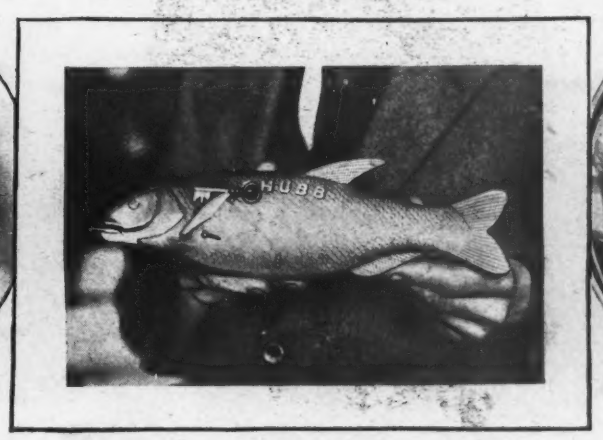
Seeing Little Things of the Sea

SOME parts of the bottom of the sea are very beautiful, as the picture below will tell you.

This picture represents a small section of a sea model that has been constructed in the American Museum of Natural History, New York.

The model, wonderfully made of blown glass and wax, is fifteen thousand times as large as the original small section from which it was constructed. It is known as the Bryozoan Group because of the tiny sea mats and mosses which it depicts.





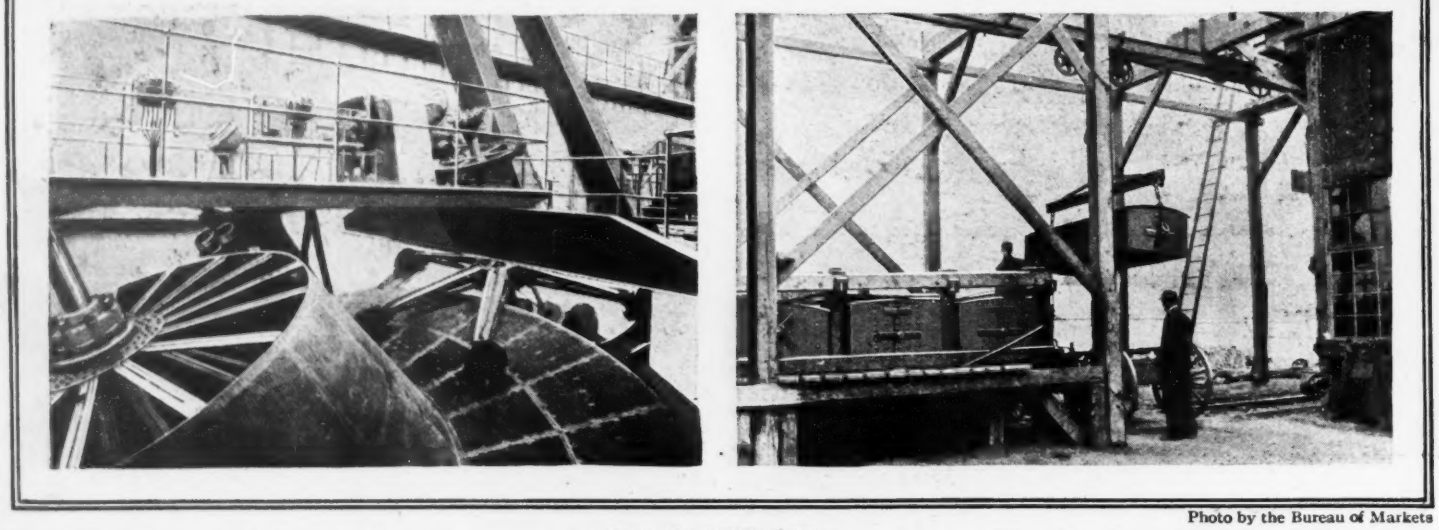


Photo by the Bureau of Markets

Straining Sewage before It Enters the River

UP-TO-DATE cities are careful about their sewage systems. They do not let sewage pipes empty directly into the rivers—at least not in Germany.

The city of Dresden has a system by which the sewage water is strained first, so that no particles larger than two millimeters are allowed to escape.

The straining is done by large revolving drums like those above. The sewage water passes over them and all heavy particles are deposited on the faces of the drums. Brushes constantly cross the drums and carry off this residue, which is later shipped to farm lands for fertilizing material.

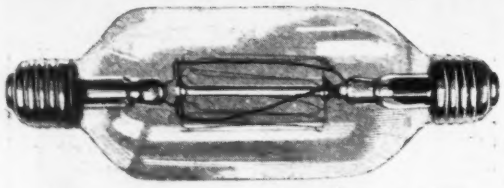
The water goes on its way and is finally pumped into the river.

Hinged Sides and Peaked Floor Quicken Car-Unloading

FREIGHT-TRAINS promptly unloaded would relieve the congestion in many of our large cities and would increase the number of working hours of the trains themselves. But can the work of unloading coal-trains, for instance, be speeded up?

Germany has found a way—her coal-trains unload themselves. Each car is placed over a pit and the side bolts are removed. A lever is turned and all four sides flare outward. The coal slides off the peak-shaped floor of the car into the pit below and in a very short time the car is empty.

This method requires the labor of one man only, and occupies but three minutes of time, thus releasing a freight-car in short order.



An Electric Lamp that Has Two Bases

MANY rooms are equipped with but a single electric-light socket—bath-rooms and bedrooms, for instance. Thus you are unable to do two electrical things in the room at the same time. The lady who wishes to curl her hair at night must perform this unattractive operation in some more unsuitable place than the bath-room or her bedroom.

But now there is a double-base electric lamp that will pass on some of the current it gets to another implement. The bases are at opposite ends of the lamp, as shown above.

Those heavy lead wires that give the lamp its current enter at one end of the lamp and continue right on through, coming out at the other end. The filament is tapped off from them. There is no tip to this lamp, and so the air had to be exhausted from it by means of a tube concealed in one of the bases.

New electrical household appliances are constantly being invented and there are not sockets enough in most houses to accommodate them all. If you want an all-electric breakfast, you need at least three sockets, and perhaps a light besides. Also in the kitchen or laundry sometimes you would like to conduct several electrical jobs at once. These new lamps will help you out considerably.

The Garbage-Can as a Source of Wealth

A MODERN King Midas, by making use of chemistry, might amass a huge fortune from the waste products of our cities. In Washington, the garbage is collected in demountable wagon-bodies and conveyed by train to the place of disposal.

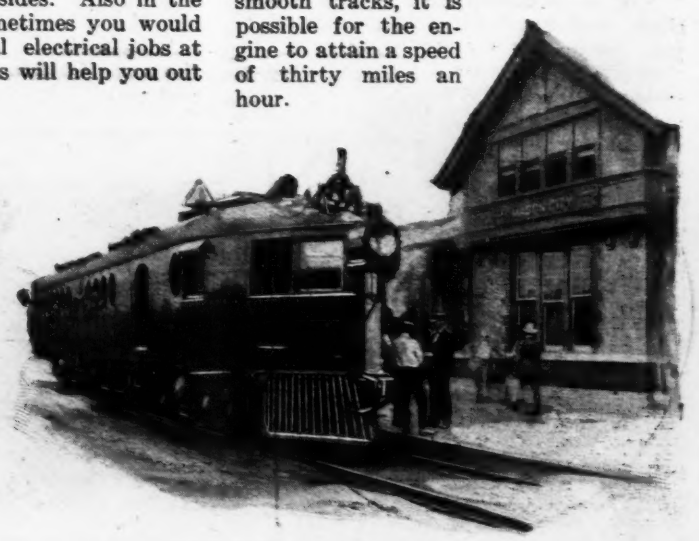
Chemists are studying the value of recoverable products from garbage, not only fats being recovered, but also fertilizer.

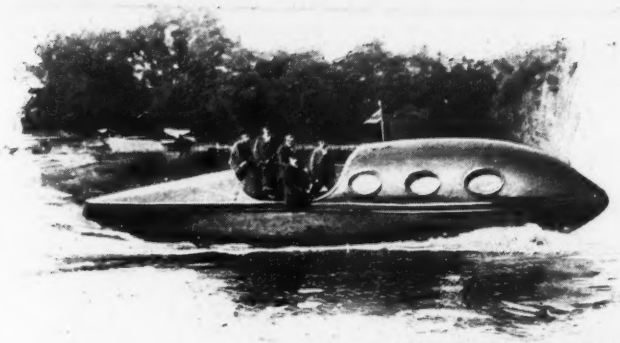
Chicago, in 1918, yielded about 4,000,000 pounds of grease, that sold for 11.57 cents a pound. The fatty material obtained from the garbage collected in Washington, D. C., was priced at 13.5 cents, and statistics from the Food Administration estimate $3,000,000 as the value of grease recoverable from the waste of twenty-four cities.

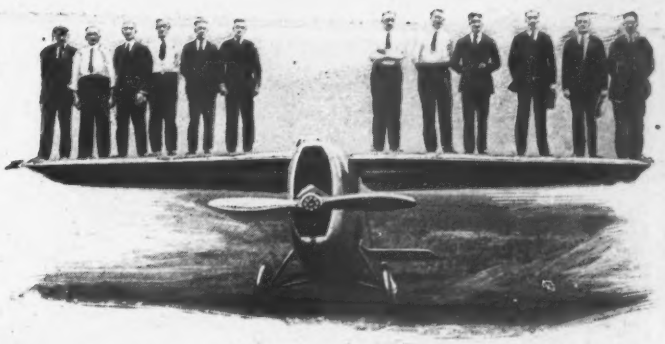
This Gasoline Engine Is Handled by a Chauffeur

THE locomotive below has neither an engineer nor a fireman; nor does it indulge in the use of coal. It contains a six-cylinder two-hundred-horsepower gasoline engine, and is one of many gasoline coaches used where traffic is light. It can be run by any automobile driver.

It is eighty feet long and is divided into four sections. The rear section is for passengers—fifty of them. Next is the baggage-room, then the smoker, and lastly the engine-room. As the wheels rest on smooth tracks, it is possible for the engine to attain a speed of thirty miles an hour.







A Speed Boat that Looks Like a Whale

BELOW the bend in the river is heard the roar of a gasoline engine working at high power.

In an instant a curious object leaps into sight, and the fishermen along the river-bank are amazed to see a large boat, that resembles a whale in shape, traveling at great speed, and apparently just skimming the surface of the water.

This is a new speed boat, a German invention, capable of making seventy-eight miles an hour. It is equipped with a 200-horsepower engine.

The evolution of swift motor-boats has been rapid in the past decade. Only a few years ago a motor-boat capable of making a rate of thirty-five or forty miles an hour was considered a wonder. Now fifty, sixty, and seventy miles are expected of the fastest of these craft. Perhaps it will not be long before we shall see them travel at one hundred miles an hour!

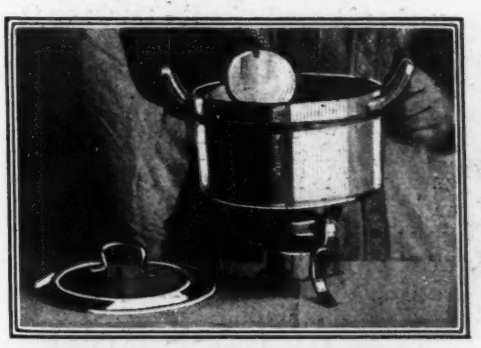
To Keep the Milk from Boiling Over

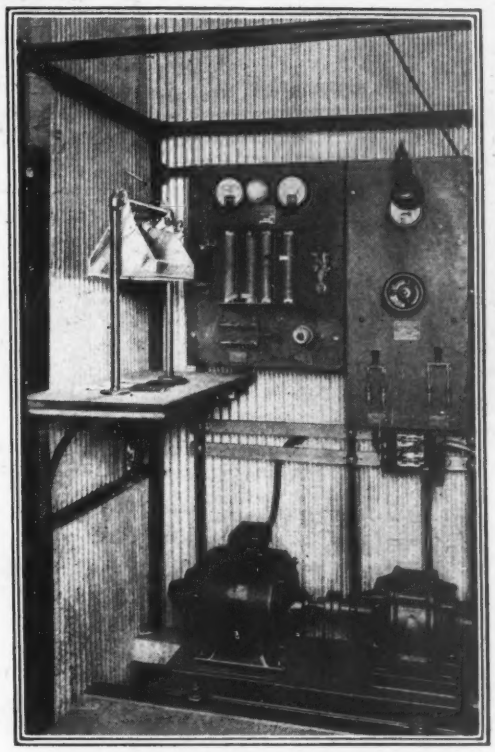
A GERMAN inventor has conceived a method for preventing milk from boiling over.

A metal plate, slightly convex, is placed on the bottom of the pan in which the milk is heated, with the convex side up. A chain, connecting the handle of the container with the metal plate, facilitates the removal of the disk.

When the milk begins to boil, the plate at the bottom vibrates. If no attention is paid to this signal, the milk will continue to boil, but without boiling over.

The metal disk prevents the explosive generation of steam at the hottest spot of the bottom by absorbing part of the heat and distributing it over a larger surface. When steam bubbles form, they seek to escape by raising the disk. After the bubble has escaped, the disk drops to its original position until another bubble is formed.





Testing Dyes—A New Job for the Ultra-Violet Light

DOES the color of your new silk dress endure the test of sunlight? If so, the probability is that the silk was tested for the fastness of its dye before it was put upon the store counter to be sold.

Science has discovered that the short light-waves carry the greater part of the energy that is transmitted with light. The vibrations that are too small to be seen are found in the spectrum just beyond the visible violet. These are called the "ultra-violet," and they constitute one twentieth of the sun's energy. They are exceedingly active chemically, as can be shown by taking photographs with this invisible light. But ordinary glass absorbs much of the ultra-violet, so special means must be employed to prevent this absorption if one wishes to make use of the ultra-violet.

As the rays are quickly effective in producing chemical changes of a certain kind, they can be used to determine the lasting quality of dye colors.

A special type of mercury-vapor lamp, which transmits as much as seventy per cent of the radiations, has been satisfactorily employed in testing the colors of silk. In a few minutes it accomplishes results that could otherwise be obtained only by days or weeks, even months, of exposure of the silk to sunlight. Only dyes that resist the action of ultra-violet rays should be used in coloring fabrics.

Monoplane Wings Support Twelve Men

ENTERED in the recent Gordon-Bennett Aviation Cup Race, in Paris, was a little monoplane whose wings are exceedingly strong. It was the Dayton-Wright entry. It carried a 250-horsepower motor with which a speed of more than two hundred miles an hour was attained.

One remarkable feature of this monoplane is the absence of all struts and wires, thus lessening its resistance to the air. The curve of the wing provides great lifting power. The contestants in the race demonstrated the marvelous speed that can be attained by single-seater machines. These are the "hornets" of the air, calculated to dart with incredible speed here and there, harassing the enemy in aerial warfare.

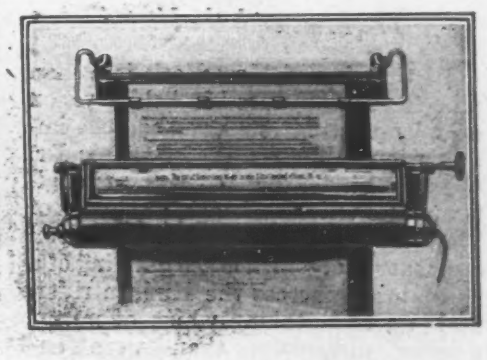
It is difficult to bring down an ordinary war-plane traveling at one hundred miles an hour; these ultra-rapid targets will exactly double that difficulty.

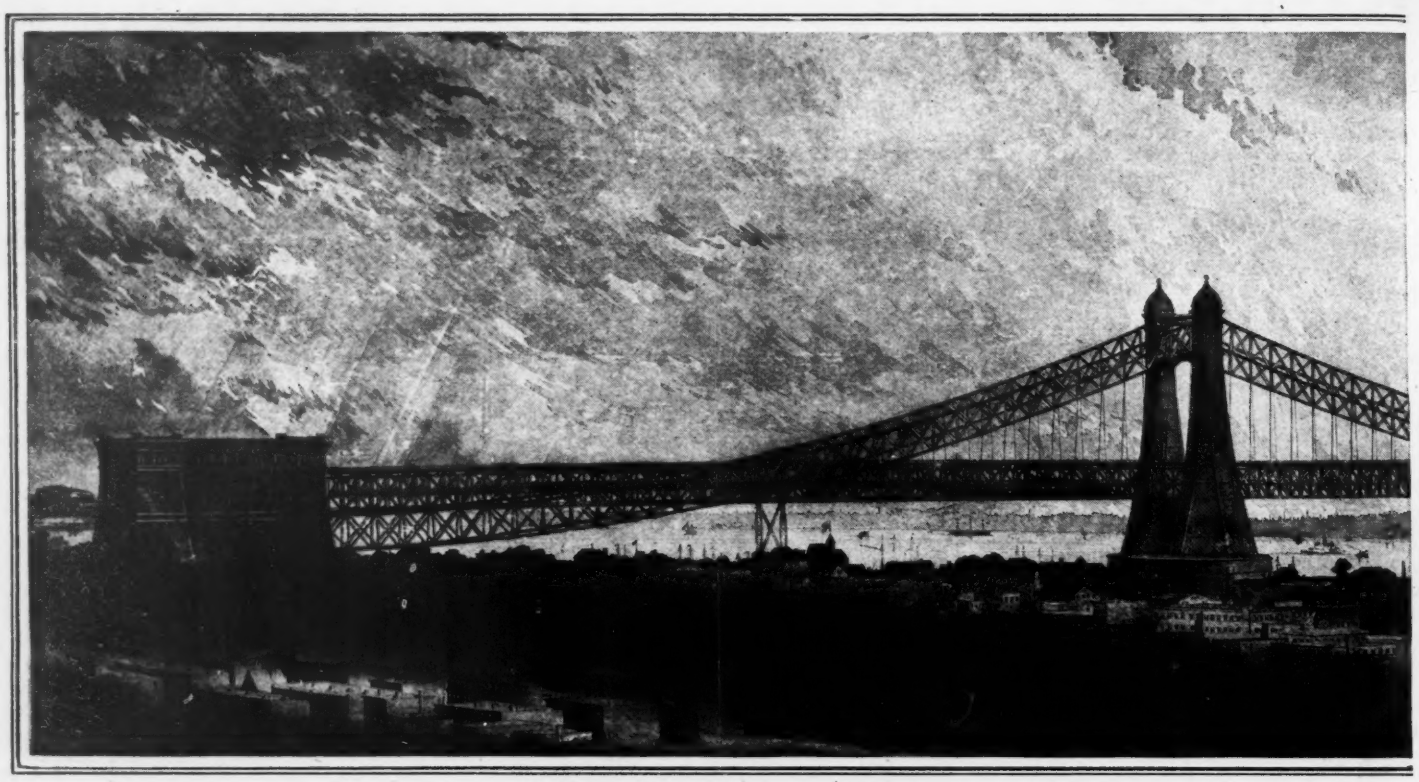
Illuminating a Line of Type for the Typewriter

THIS is a clever idea—very clever. Guess again—you are wrong. It is not simply a device with which to copy one line at a time. It is an attachment for such a device that illuminates each line.

This attachment does not reflect the light directly into the stenographer's eyes. Its inventor, Robert M. Searle, of Rochester, knew far too much of the science of light to make such an error as that. It merely illuminates the line, which is seen through a long, thin magnifying-glass. A tubular electric light of special construction sheds its rays on the line to be copied. A ray-filter prevents the harmful red rays from reaching the paper. No matter what the time of day, this lighted line is always on duty.

Not only does it relieve eye-strain, but it also increases production. Human beings cannot work faster than their eyes will permit. Better sight, better work.





The main span of this gigantic bridge across the Hudson river will be feet in diameter. The weight of the metal in this bridge will be so

Connecting Manhattan Island

Gustav Lindenthal's splendid promises to bring to reality a

PUT two million eight hundred thousand people on an island, give them houses, subways, surface cars, factories, stores, and all the equipment of a city—but fail to provide a means of reaching these people with the materials with which their factories can work, fail to give them fuel and food—and the vast population of the isolated island will perish. The means of conveying material, food, and fuel to the citizens of the island-city is of utmost importance. Manhattan island must be hooked up to the United States, and many plans have been suggested to accomplish this ambitious purpose.

The great arteries of circulation, the railroads, extend to the shore across the river, but, with only one exception, they do not bring their trains of freight and passengers directly into Manhattan. All the material carried by these outside lines must be transferred and rehandled before it is conveyed across the river to be distributed. This involves expense which is reflected in the cost of living. Long Island and Manhattan are connected by bridges as well as tunnels. Why have we waited so long before attempting to bridge the Hudson?

The Man with the Vision

In the city of New York is a man who for thirty years has held a vision so splendid that few have had the imagination to appreciate it. He is Dr. Gustav Lindenthal, consulting engineer. His vision centers in a solution of New York's transportation problem, one feature of which is the building of a great bridge across the Hudson river. It is an undertaking which offers far greater difficulties than were encountered in building any of New York's present bridges.

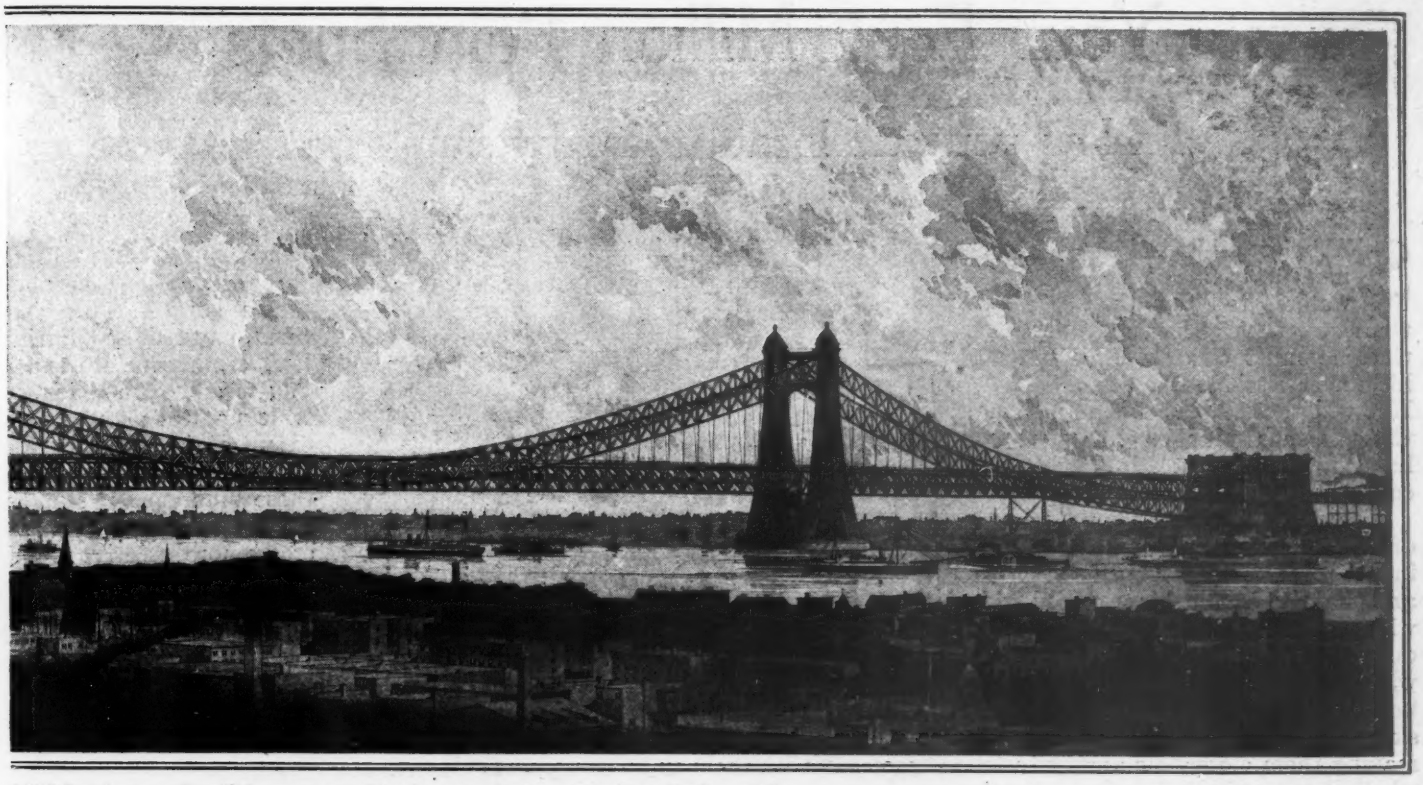
The Hudson river flows serenely along the western edge of the island of Manhattan. From the north it comes, and the early settlers called it the "North river." To build a bridge across it in the vicinity of New York would be a simple matter if the bed-rock bottom of the wide stream were not so deep. To reach the basic underlying rock the builders would have to bore downward through from 250 to 350 feet of silt and mud.

To build a pier in the middle of the stream would be an impractical task, owing to the great depth to which the construction would have to go before reaching the rock base. Besides, government regulations would prohibit an obstruction in an important waterway. A feasible alternative is the construction of two piers, 600 feet high, one on each side of the river, resting there on the easily accessible rock. These piers will carry the cables to support a great span, 3200 feet long and about 200 feet wide, twice the length of the main span of the Brooklyn bridge. The weight of steel in this bridge would be enormous. In fact, the weight of the main span of more than half a mile is such that the heaviest load crowded upon it is a mere nothing in comparison. Mr. Lindenthal has remarked that the string of heavily loaded trains and vehicles crossing the bridge would be no more, as an addition of weight, than a procession of flies walking along a heavily loaded clothes-line.

Railway Tracks on a Double Deck

The chief purpose of the bridge is to bring the New Jersey railroads into the heart of Manhattan. Fourteen tracks on a double deck would accomplish this purpose. Eight of the tracks would be used for freight and passenger trains, while six of the tracks would be used for trolley-cars or traction trains. Besides, there would be two broad driveways for motor vehicles and two promenades for foot passengers. The weight of the rails for the tracks on the main span alone would amount to scarcely less than 1200 tons, but this again is insignificant compared with the weight of the steel girders, trusses, and cables. Four wire cables, encased in non-corrosible envelopes eight feet in diameter, would be required to suspend the massive framework of the bridge. The cables supporting the Brooklyn bridge are but fifteen inches in diameter.

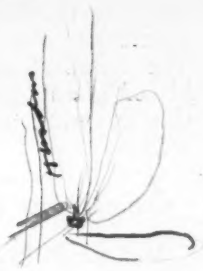
To say that the span of this huge



3200 feet long. It will be supported by four steel-wire cables in cylinders eight
enormous that all the traffic that can be crowded upon it will be negligible

with the United States

bridge to span the Hudson vision of thirty long years



bridge is 3200 feet in length does not convey a good mental picture of it. The Woolworth Building is the world's tallest building. It is 792 feet in height—a tower of steel encased in masonry and concrete. Stand four of these structures on top of each other, and you can form a vague idea of the massive steelwork required for the construction of the main span of this titanic bridge. Instead of carrying its own weight skyward, this colossal load of metal must be suspended by cables in a horizontal position.

The bridge itself is but a factor in the scheme to relieve congested transportation in the port of New York. To complete the chain it will be necessary to connect the bridge terminal at Fifty-ninth street with a terminal at the Battery, the tip end of Manhattan island. This would constitute a belt-line of elevated railroad tracks over which the trains could pass on their way back to New Jersey through a proposed tunnel at the Battery. A great central union station is also a part of the plan.

Ten thousand cars of freight could be moved over this route every twenty-four hours, and six million motor vehicles could cross the bridge in a year. The suggested system of financing the whole enterprise does away with the necessity of delaying traffic to collect tolls. Automobiles would have an easy access to Manhattan from New Jersey, and by making use of the present East river bridges would have a direct passage to Long Island. No less than eighteen tunnels under the North river would be required to accommodate the traffic which would pass over this single great bridge, and the cost of that number of tunnels would be at least two thirds greater than the cost of the bridge.

A Monument to Our Age

The building of a massive structure of steel across the Hudson would be a fitting monument to our Age of Iron. Its completion would mark a new wonder of the world, ranking as an engineering undertaking far above the construction of the Pyramids. Its service would be to the humanity of future generations, though nothing could be more appropriate as a monument to the heroes of the late war.

In ancient times bridges were built as monumental structures. Why not have this modern enterprise a "Hudson River Memorial Bridge"? Massive arches of sculptured stone forming the bridge approaches would carry out the idea and visualize the part our country took in the world war. Hidden within the bridge structure would be the arteries of transportation, reaching from beyond the Palisades and bringing into the heart of New York the materials necessary for the life and industry of its millions of inhabitants. What could be more splendid than a "living monument," rather than one purely ornamental and lacking a vital contribution to humanity?

But how is the money to be raised for such an enterprise? That is the question which has been the chief concern during the thirty years since the idea was realized to be a mechanical possibility.

How the Project Is to Be Financed

Mr. Lindenthal's scheme is as unique as it is feasible. It overcomes what he considers to be the greatest obstacle in the way of accomplishing the actual building of the huge suspended roadway across the river.

"The communities on each side can pay their share in the form of yearly rentals," says Mr. Lindenthal; "so also can the railroads. The respective shares can be adequately determined to cover operation, interest, cost of maintenance, and taxes." A separate terminal organization would act as agent and trustee for the Federal Government, while private capital, realizing the advantages to be conferred, can be relied upon to come forward with the required funds for building, equipping, and operating the vast project. Cooperation between the railroads, the city of New York, and the communities on the New Jersey side, and the Federal Government, will assure this method of bringing to life the vision of thirty years.

Your Four Million Pain Spots

How you can locate them by simple tests

By Latimer J. Wilson

SET before a blindfolded man a basin of ice-water; tell him that the water is very hot, and that he must quickly dip his finger-tips in and out. He will actually believe that he has plunged his hand into hot instead of cold water.

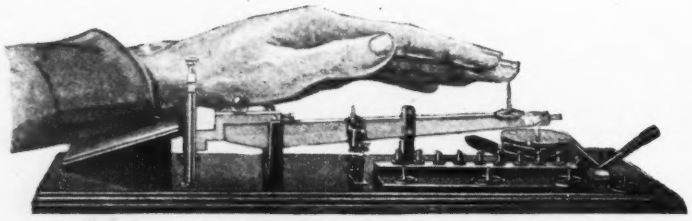
Place two needles about one-quarter of an inch apart in a piece of cardboard and lightly touch his exposed skin without permitting him to see how it is done. There are spots on his body where he can not tell whether one or both points are being pressed upon his skin. By separating the points, or making them closer, his ability to tell whether one or both points are touching him, will vary through an astonishing range.

Cold, warmth, touch, and pain, are the four sensations produced by nerves whose "receptors" lie in the skin, or just beneath it. Some nerves terminate in bulb-like bodies which differ in form, those of one type being receptors for cold, while those of another type receive the stimulations of warmth, though the sensation of warmth arises from the effect upon the cold bulbs, as well as upon the receptors of warmth. The free nerve ends which do not terminate in these bulbs or masses are those which convey the sensation of pain. The sense of touch is also carried by a separate nerve-ending.

The nerve-endings are distributed over the whole body in microscopic dots, forming little groups in a given area. It is estimated that there are between two million and four million pain spots on the body, while there are five hundred thousand spots of cold and an equal number of touch spots. There are only thirty thousand warm spots, and since one depends upon them for the sensation of exterior warmth, he must stand close to the fire on a cold day.

Cold Spots Predominate

The five hundred thousand cold spots also respond to the stimulus of warmth, but their response is that of cold and not warmth. This curious fact may explain the confusion which often arises in attempting to distinguish between hot and cold, particularly when dipping the finger-tips quickly into ice-cold water and as quickly removing them.

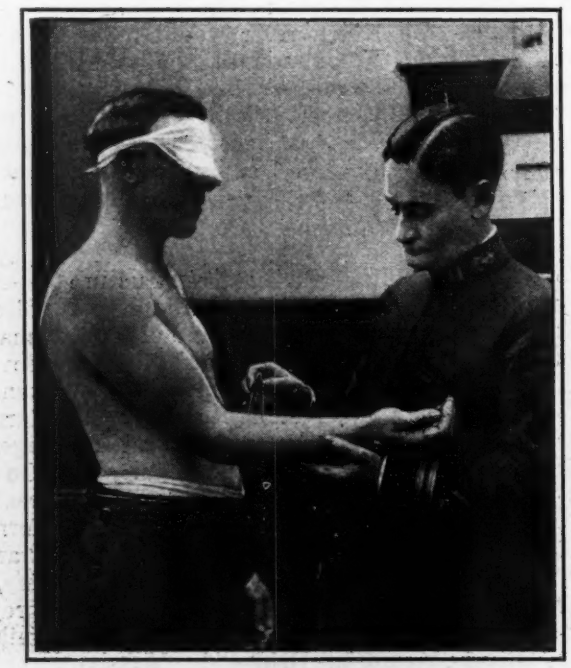


An instrument like a balance scale is used to measure the amount of pressure required to produce the sensation of pain

The free nerve-endings which receive the sensation of pain are distributed widely over the whole body. But there are areas which are more densely "spotted" with them and where pain is more keenly felt. The pain spots are particularly numerous in the cornea of the eye—the transparent surface that covers the iris and pupil of the eye. The smallest splinter of metal or bit of glass that finds its way into this covering produces the greatest pain.

Comparisons in Body Sensitivity

Measured in numbers by which comparisons can be made we might say that the top of your head is about eight times more sensitive to pain than the back of your body. Numerical "weights" rate the forehead's sensitivity to pain as 1.3; the right temple, 1.0; left temple, 1.3; right thigh toward the abdomen's surface, 4.3; left hand, palm side, 6.2; right heel, on the side of the sole, 7.0; and the back, 8. Thickness of skin and the extent of the sub-cutaneous tissues largely determine these differences. But the left side of the body is generally more sensitive to pain than the right.



Touch the skin of the forearm with one or both prongs of a hairpin and see if the person can tell whether one or both is used. Pressure on a hair is strongly felt

Special instruments have been devised for finding out the spots of touch and those of pain. Electrical methods have also been used for this purpose, but the results obtained by electrical means do not agree with those of mechanical methods.

One of the simplest "pain-finders" is a small scale-like device by which weights can be added to press a sharp point into the skin. Difficulty has been encountered in making the subject discern the difference between mere discomfort and actual pain.

The pain threshold, that wavering uncertainty which barely marks the merging of consciousness into pain, increases in definite realization in curious proportion to the area of the skin exposed to the stimulation of pressure. Thus an instrument which affects a minute area of the palm of the hand and which produces consciousness of pain with a small weight, would with nearly five times that weight affect similarly an area twenty-seven times as large.

Variance in Sensitivity

The tips of the fingers are particularly sensitive to touch, but the degree of sensitivity varies considerably in different people. A man whose hands are rough and whose finger-tips are thick, feels touch less keenly than a pianist. Fingering the strings of a violin tends to make the tips of the violinist's left hand less sensitive than are the hands of a musician who plays an organ or a piano.

Each finger differs in sensitivity, and there is often a considerable difference between the fingers of each hand. On the inside of the cheek little pain can be felt because of the lack of the nerve-fiber endings. Spots of cold are particularly numerous on the inner surface of the eyelids, on the white of the eye, and on the forehead. These spots quickly

respond to the sensation of falling temperature.

The hairs on the body might be compared with levers exerting pressure on the skin, thus increasing its sensitiveness to touch. Lightly press the tip of one finger upon a clear space on the forearm, then barely touch a hair near this spot and note the difference. The single hair irritates a smaller area than the finger-tip and thus a lesser pressure is required to stimulate the end of the nerve. A light pressure with a needle-point is more effective than the pressure exerted by the end of a match, because the latter affects a larger area.

Some of the Experiments

In this connection it is interesting to consider the experiments which have been conducted with the aid of instruments to determine the curious effect known as "dual cutaneous sensitivity." Two fine points, two needles in a cardboard support, or the fine points of a small hairpin spread about one-quarter of an inch apart, serve to demonstrate the effect. When these points are gently pressed upon the skin of the arm, forehead, finger-tips, or back of a person who cannot see them, he may not be able to distinguish whether one or both of the points are used.

In some places the sense of touch is so keen that the points may be barely separated to be felt separately. In others, the points will have to be very wide apart to be distinguished as two separate centers of pressure. The results differ in individuals, and the tests are used in psychological experiments, especially in criminology.

A sudden increase in temperature causes pain, while the same degree of heat if gradually attained causes no pain. It is just the opposite with pain from pressure. The sudden impact of a bullet deadens the sensations and no pain is felt; while the gradual pressure of a knife causes pain.

The back is less sensitive than the forearm or the forehead. It is often difficult to detect the impression of one prong of the hairpin from that of both prongs unless they are wide apart

Emotion Deadens Pain

A nervous impulse of emotional character also deadens the sensations of pain and this explains why one may receive a wound during emotional conflict without knowing it. Such a condition is accounted for by the fact that the nerve-ends receive the stimulation, but the nervous impulses do not reach the seat of the nerve to convey a conscious condition. This is illustrated by lack of senbility to pain during hysteria.

Why is it that persons sometimes feel pain in an amputated hand or foot? Such are called "propagated" pains. They originate in the trunk of the nerve, but are felt in the nerve ends.

Some pains are associated with parts of the body to which they may not be accredited. This is due to a transposition of the "nervous impulse," and can be illustrated by "pain in the knee caused by toothache," or pains in the head from intestinal trouble. In this case the false effect is due to an excitation of the brain areas that are aroused usually only from the sensations received at the ends of certain nerves.

Why Aren't We Killed by Hailstones?

THE hailstones shown in the accompanying photograph did not break any records, and neither, so far as we can learn, did they break any heads. This leads us to propound a question that has fretted us for many a year: Why don't these aerial bullets kill people?

One answer, of course, is that they do. We have searched the literature of meteorology, and we find that Sir John Eliot, late director of the Meteorological Service of India, once published descriptions of all the hailstorms recorded for a long period of years in that country, which seems to be more subject to severe visitations of this character than any other part of the world. In about half a dozen of these Indian storms human beings were killed by hail. In one case, in the Moradabad district, May 1, 1888, it is said that 250 persons thus perished. But such occurrences are, apparently, almost peculiar to India, and very rare even there. There is only one record of death by hail in Europe. We do not know of any in the United States.

The velocity attained by a falling hailstone can be gaged by the fact that, even when falling obliquely, hailstones have been known to pierce a pane of glass with a clear, round hole, like a bullet-hole, leaving the rest of the pane intact. They have also been found imbedded in the soil of a meadow to a depth of a foot and a half.

A severe hailstorm that prevailed in Maryland, June 22, 1915, was remarkable not only for the fact that the newspaper reports considerably understated the size of the stones, very many of which were actually as big as a baseball or an orange, but also because —again the mystery!—nobody was killed or badly hurt. Describing the storm as it prevailed at Annapolis, Dr. O. L. Fassig, of the United States Weather Bureau, wrote in the *Monthly Weather Review:*

"It is rather remarkable that such a shower of stones lasting from fifteen to twenty minutes and passing over a city with a population of approximately ten thousand, should have caused so little personal injury. The writer heard of only two men who received scalp wounds of sufficient severity to require hospital treatment."

More than "rather" remarkable, we should say; it requires elucidation.

Hailstones that fell at Lake Minnetonka, Minnesota. Some of the stones were fifteen inches in circumference; some looked like clusters of crystals; some like round, smooth balls. Most of them were shaped like a tomato

Killing a Bear with Electricity

An adventure that might have been disastrous but for quick thinking

By C. B. Horsley

IT was a small power plant hidden away in the foothills of the western range of the Rockies. Three men ran the plant, Edwin Green, Robert Egerton, and William O'Day. O'Day was away repairing the line. Egerton had gone to a town six miles away for fresh supplies, leaving Green alone.

It was a lonesome place. Yet so little was there to fear that there was not a cartridge in the house at the time, though Egerton was to bring some back with him. There was nothing to steal, and as for wild animals—nothing bigger than a rabbit had been seen in the neighborhood for three months.

Everything about the plant was running as smoothly as clockwork. Green took out a book and sat down by an open window to read. It was the first warm day since a hard winter. Suddenly the air became warmer, and Green heard slow, heavy breathing.

The bear roared, coming down with his front feet on the iron bars. There was silence as every muscle tautened, then the bear fell in a lifeless heap

Outside the Window

"Even to this day," says Green, "I have wondered why, after I distinctly perceived this, I waited nearly a full minute before looking up. Perhaps I was so interested in my book that I imagined it was the horse I was reading about that was breathing so close to my face. But, whatever I imagined, my thoughts suddenly changed when I looked up and saw a huge grizzly bear standing outside the window, not two feet away, with his head pointing directly at me.

"Fortunately—very fortunately for me—the windows were barred and the door was closed; but I was so taken by surprise that it took me a few minutes to realize that I was not in immediate danger. The bars were extra heavy and the door was also heavy, with a strong latch on it. When I realized that I was safe, I began to laugh at my fright, for I had knocked over several chairs and a table in my hurry to get away. The bear, however, did not go, as I at first expected he would, but began walking up and down in front of the building. He even put his front feet up to the bars of the window in his attempts to get in."

The affair now took on a more serious aspect—that of a siege; especially since the bear seemed greatly infuriated when Green tried to frighten him away by throwing things at him or by making a noise.

At the end of an hour the bear seemed as little inclined to leave as Green was to go out and make him. Green began to get worried.

Egerton was due back very soon, and he carried no gun. Moreover, he would come by the back of the house and would not be able to see the bear until he was practically upon it. Something must be done. There was no way for Green to warn him, since there was no opening or window of any kind in the back part of the house.

As the time approached for Egerton's return, Green's anxiety increased. He searched frantically for some kind of weapon that would kill the bear, which was striding restlessly up and down outside the window. He could not take a chance on anything that would merely wound the animal, for in that case it would be doubly dangerous to anybody within its reach.

Finally Green decided on a plan. Although the house was built of brick and concrete, the bars of the windows were entirely embedded in wood. This would serve very well as an insulator. He connected one wire, leading from a terminal of one of the transformers, with the bars of the window, and the other wire he grounded.

The End of the Adventure

The next time the bear came in front of the window, Green seized a bamboo fishing-pole and started poking him with it. This maddened the animal to a fury. He let out a roar, and, rising up on his hind legs, came down with both of his front feet against the iron bars.

There was not a sound, not a whimper. Every muscle in the bear's body went tense for a fraction of a second. Then he relaxed and fell limp to the ground. Such a terrific electric current was too much for any grizzly to endure.

Propelling an Airplane by Kicking the Air

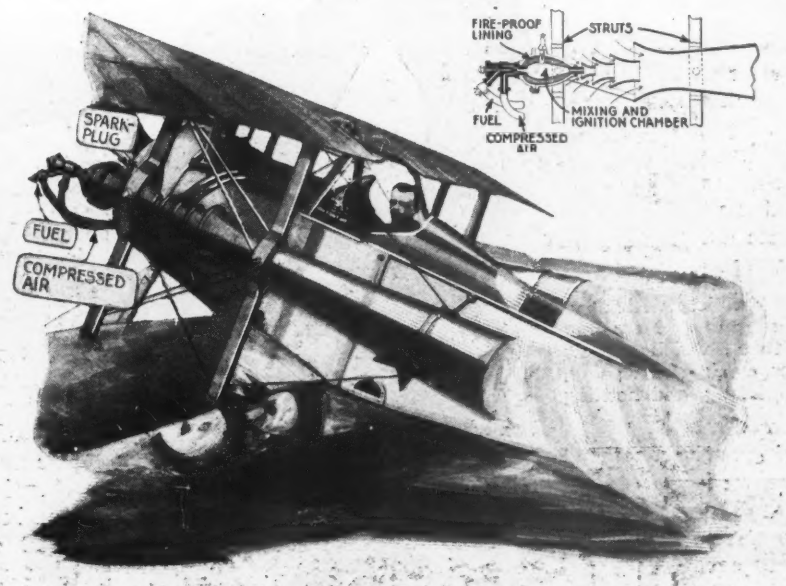
How Mélot would use blasts of burnt gas and air

By Marius C. Krarup

AVIATION engines utilize at most thirty per cent of the fuel value, and at low airplane speeds the propeller screw and the engine jointly drop to twenty-five per cent of their maximum efficiency. There is therefore left only seven and one-half per cent of efficiency for the conditions which are normal for getaway and uncommon for landing, the two most important and ticklish phases in the operation of an airplane. To have useful power left for this condition, as well as for maximum speeds, large engines must be used, and, as they must be at the same time of little weight, they are delicate and need constant and expensive attention to keep them in reasonably safe working order.

At the recent Aeronautical Show in Paris, a propulsion engine, developed by F. Mélot, was the most radical exhibit. Mélot's idea is intended to get away from the enormous waste and risk in operation of aircraft which present methods involve.

According to Mélot's plan, there is provided a simple engine, which, by continuous combustion of any liquid fuel, or even powdered coal, produces a blast of burnt gas and hurls it against the atmosphere to the rear with such high velocity and peculiar motion that the atmosphere cannot get out of the way very fast, wherefore the structure in which the blast engine is mounted goes forward instead, by reaction from the resistance met in the atmosphere.



Air and fuel are shot continuously under high compression, in proportions regulated by a needle-valve, into a fireproof combustion chamber. Here it is fired by a spark-plug, to start the engine

Producing Atmospheric Resistance

The important part is to make the blast whirl and spread *before it leaves the engine* in the most suitable manner for producing atmospheric resistance, and while very little is known on this point as yet, it is probable that not only must the blast have high velocity, but it must also be made to whirl around a partial vacuum along its axis (as a tornado is believed to do), into which partial vacuum of conical shape the atmosphere will be continuously forced from behind by atmospheric pressure. On any other supposition the jet or blast would, on leaving the engine, impinge against its own vanishing wake with small resistance.

To have the blast operate as a jet, piercing the atmosphere almost as a projectile, is the one thing to be avoided, because the reaction to be used for propelling the engine and the structure cannot be stronger than the resistance met in the atmosphere. The mass and velocity of the blast are therefore of secondary importance, deciding results only when the other factors mentioned are equal. In all previous experience with jets of gas, air, or steam, the results have been poor, because those other factors were wholly neglected. The Mélot propulsion is only a first step in the better direction.

Air and fuel are shot continuously under high compression and in proportions regulated by a needle-valve into a fireproof combustion chamber. Here it is fired by a spark-plug, to start the engine. The exhaust passes out of it by a small blast-pipe or nozzle, which projects freely toward the middle of the first of a series of conical expansion tubes, and there discharges a thin stream, equal to the muzzle velocity of rifles.

The conical tubes are shaped and spaced as shown.

Owing to the blast velocity and the hot gas expansion, air is siphoned into the forwardly flaring mouth of the first cone, aided by the forward movement of the machine, and mixes its volume with that of the jet while receiving motion from the latter. This is repeated with increasing expansion and diminishing velocity at each of the following cones. In the last one, which is much the largest, the whole mixture of gas and air finally leaves the apparatus with such thrust and reaction as may be accomplished by this method.

In this mechanism several points are of special interest. The small bore of the blast-pipe in the combustion chamber must cause a very high back-pressure in the latter, and this may operate on the continuously fed fuel and air as compression of the explosive charge operates in an ordinary automobile engine. This may be vital for efficiency. On the other hand, to feed air and fuel against the pressure in the combustion chamber must require a special engine for this purpose. How much reaction of value for the propulsion can be derived directly from the emission of the jet is one of the knotty questions.

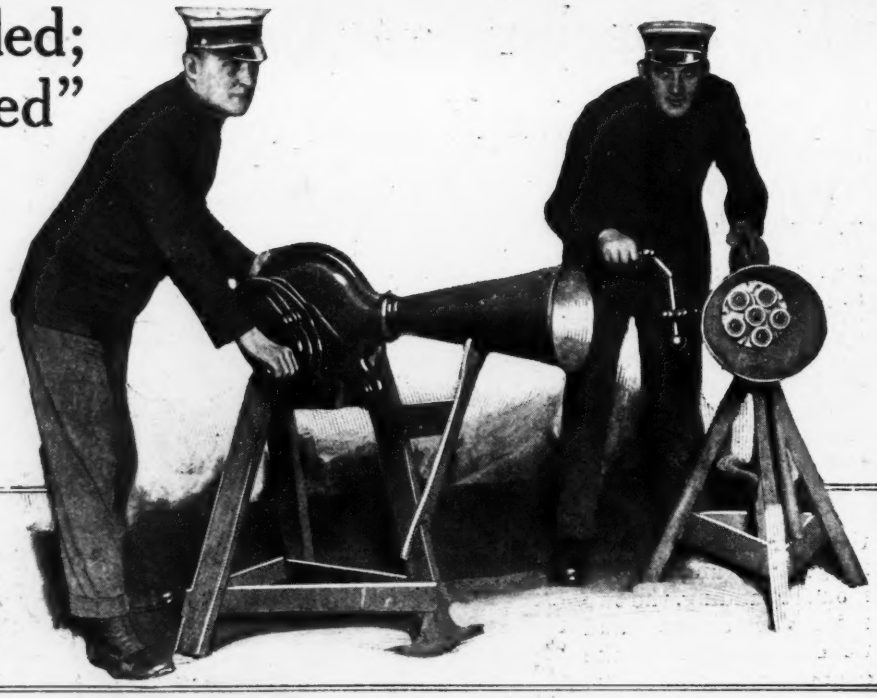
If the initial velocity of the jet does not fall below 1100 feet a second, equal to that of sound waves, in the large expansion tube, there is, according to other experiments, a likelihood of wave motions and strong reactions.

Better at Low Speeds?

It is stated that the trial machine which was exhibited in Paris developed 30 horsepower, at a relative speed in the atmosphere of 164 feet a second (about 107½ miles an hour) and produced a propulsion thrust of 100 pounds. But these figures are meager and give practically no information on the important question of how the thrusts are affected by speed. From the nature of the machine it seems likely that it would operate much better at low than at high speeds. If the figures were thoroughly favorable, more of them would have been given, The high relative speed of 107½ m.p.h. may have been determined by wind-tunnel or laboratory tests. The thrust of 100 pounds figures out 30 horsepower, however, at this speed. The weight of the machine is given as 1.1 pound per brake horsepower. It is about 5 feet long.

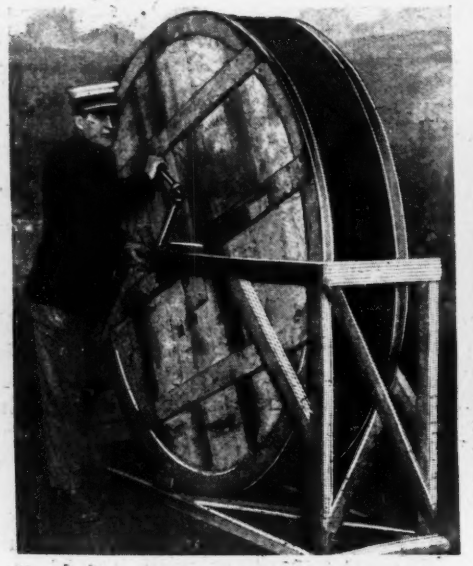
"The Earth Trembled; the Heavens Dropped"

Showing what is behind those realistic noises we hear in the theater



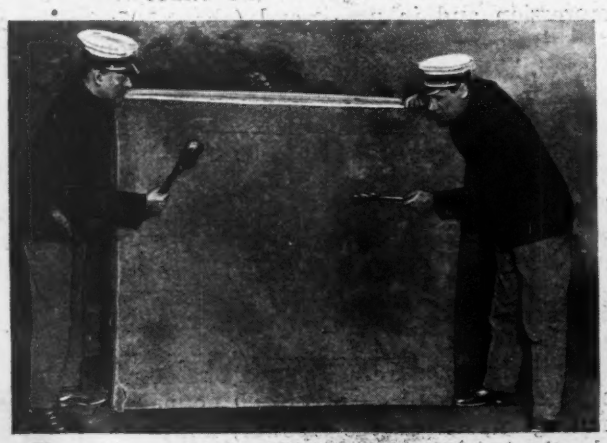
No theater is complete without a wind-making machine. Here you see two of them, which register wind near, far, coming, and going, as well as whistling and howling

Crash! A great tree falls in the distance. The real crash was the knocking of wooden slats against a block. As the man turns the handle the slats strike the block



You'd never suspect dried peas of having theatrical aspirations; yet they have. This great wheel is filled with them. When the handle is turned, they rattle against a screen and sound like rain

A shot is heard in the distance. The blow of a rattan rod on a leather cushion was what you really heard before they brought the hero in on a stretcher

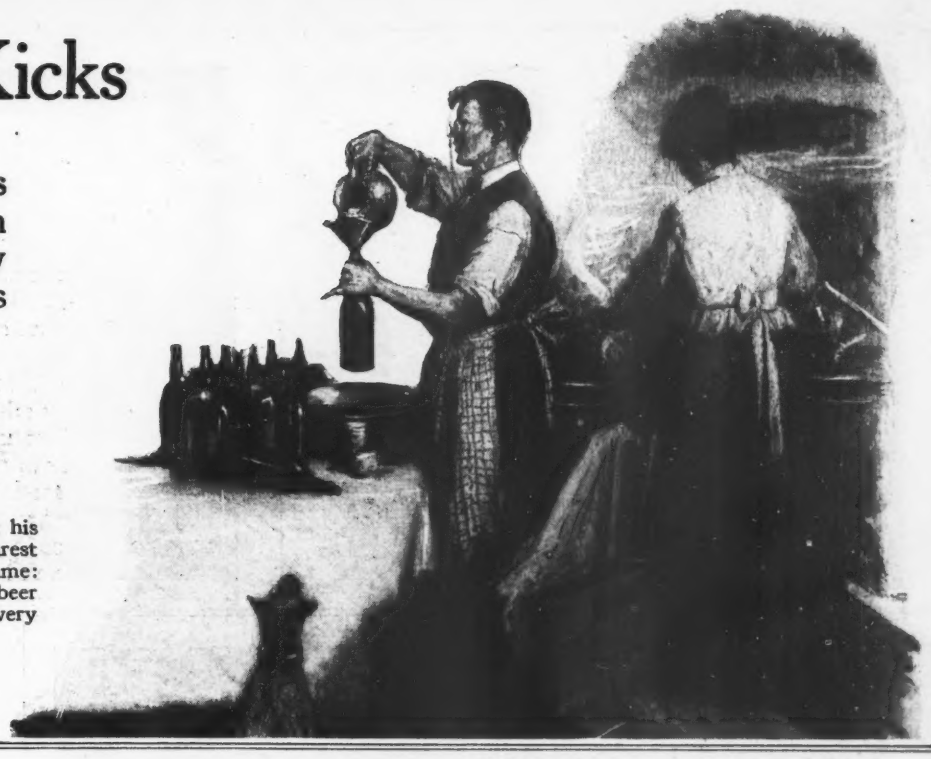


Sheepskin may be used for dignified diplomas, or it may be used as a thunder-maker. The skin is stretched over a square oak frame and attendants pound on it

She makes a noise like a horse. When the hero gallops away, she stands behind the scenes and registers beating hoofs by means of a pair of horseshoes mounted on wooden blocks

Homemade Kicks

And the law allows you to use them if you don't show any after effects



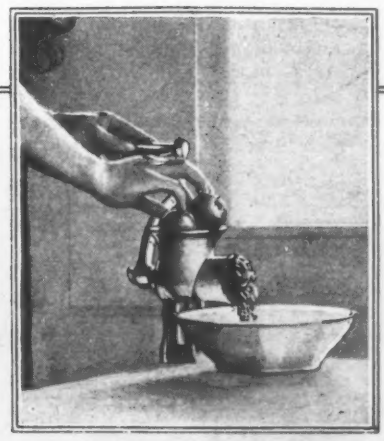
If you tell a little boy not to get his feet wet, he'll run for the nearest puddle. Grown-ups are just the same: many people who never drank beer and wine now do a rushing brewery business in their own kitchens

A glass of near-beer—that's what the man above ordered. And when he got it, he poured twenty-five drops of tabasco sauce into it. The beer came to life—and so did he

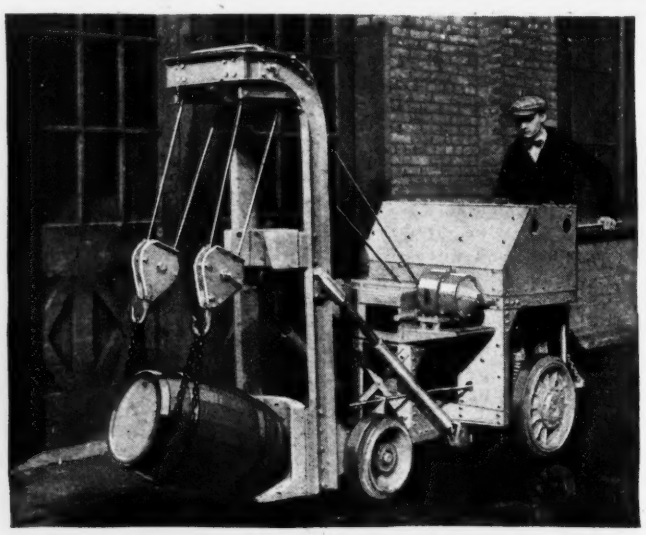
That bottle of lemon extract has unlimited possibilities. Empty it out, except for a teaspoonful, and then fill it up with near-beer. See if you don't get a shock

Snuff is in vogue once more. If you chew some until it becomes a soft paste, and keep it under your lip, you will soon feel as you did when you drank wine like water

Wines may be made at home, provided they are kickless. Here's a recipe: boil ten pounds of ripe dates forty-eight hours, put the juice in jars, and bury the jars for twelve days. Then see what happens



If you run apples through a chopper, strain the juice, let it stand till it ferments, and then drink it, you will suffer more pleasure than pain. It's against the law



She's a Brute for Strength

JUST think of eighteen straining horses in a row, and you will get some idea of the power carried by this boat. It is the *Maple Leaf*, one of the English contestants in the recent international motor-boat races.

Although this boat carried four engines, it lost the race. *Miss America*, with her two engines, was an easy winner. Engine trouble prevented the *Maple Leaf* from winning the race.

Four engines are all right when they are running, but they are worse than only two when they go wrong. It is a case of more engines, more trouble.

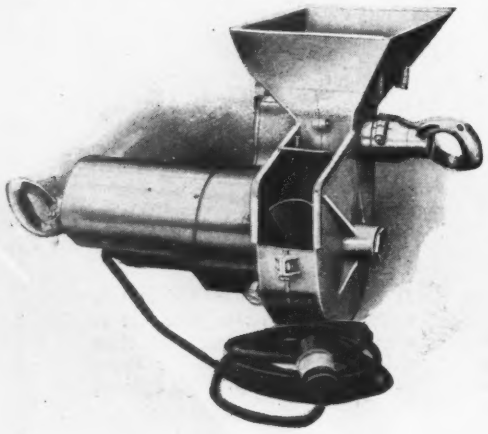
Miss America gave very little trouble, while the larger boat needed attention.

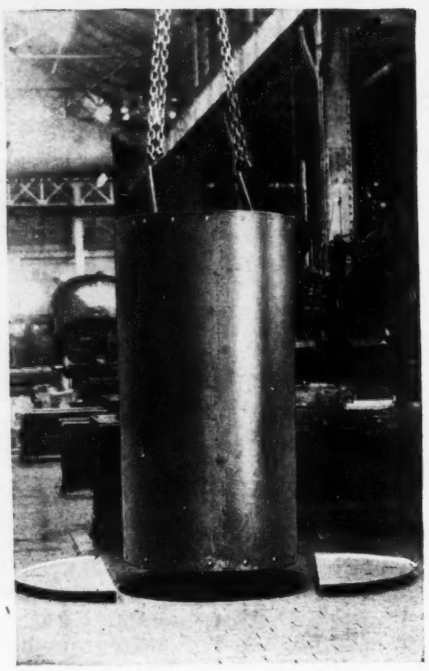
Electricity Stuccos the Walls

MODERN stucco-workers discard the old method of laboriously putting on the stucco by hand. They make use of a recently devised machine, that weighs only thirty pounds, but that has a capable motor, and that can be connected with any light-socket. It puts the stucco on a wall at the rate of one and one half square yards, one quarter inch thick, in one minute!

Not only is it a useful device for builders, but it serves as a life-saver in mines, where the rough surface is made more safe by a protective coating applied with the machine.

This machine also stops leaks in mine-shafts and air courses.





A Scrap-Bucket in the Floor

THE floor-sweeper in this machine-shop has an easy job. When he sweeps up the valuable metal scraps left by the boring-mills, lathes, and grinders, he does not have to stoop to scoop them up. He sweeps them directly into this huge bucket, which is placed in the shop floor.

When the bucket is full, along comes a crane, picks it up, and takes it to the scrap-metal car, where it is dumped.

Such a bucket effects a great saving in shops where several carloads of metal scraps are salvaged every week.

A very heavy cover is placed over the bucket when it is in position, its rim flush with the floor, so that the factory trucks may pass over it without doing any injury to either the bucket or the trucks.

The bucket is large enough to hold the sweepings of several days before it is necessary to dump it. It has a capacity of several tons.

Although very substantial, the bucket is not heavy.

The New Baby Crane

A SMALL crane that can be rolled around a shop to pick up heavy pieces of metal or other objects has recently been invented.

It gets its power from a storage battery that it carries around with it. A chain is placed around the object to be moved; then two hook-blocks, attached to the crane by cables, are hooked to the chains. Next the motor is started.

Slowly the cables wind around drums and the burden is lifted off the floor.

In this way one man can handle weights that would otherwise require many men to manipulate.

How to Thaw Frozen Pipes

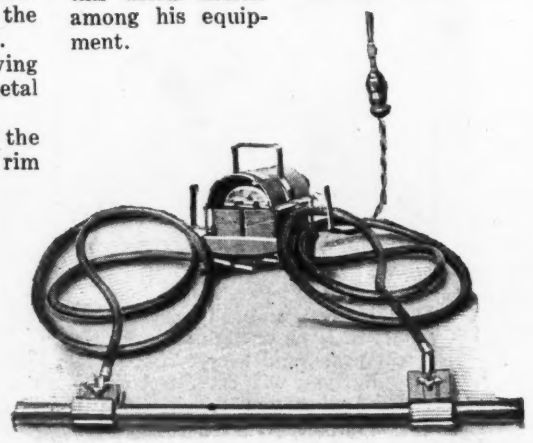
INSTEAD of running the risk of setting your house afire with a blow-torch when the pipes freeze, it is now possible to thaw them with electric power.

Here is a device as simple as an electric iron, which uses just about as much current. By merely attaching it to the frozen section it soon heats the pipe sufficiently to start the flow of water.

It is possible to thaw out pipes fifteen feet in length.

The base of this "pipe-thawer" is made of cast iron and the cover is of pressed steel. It is easily carried from place to place.

Every up-to-date plumber should have this useful article among his equipment.

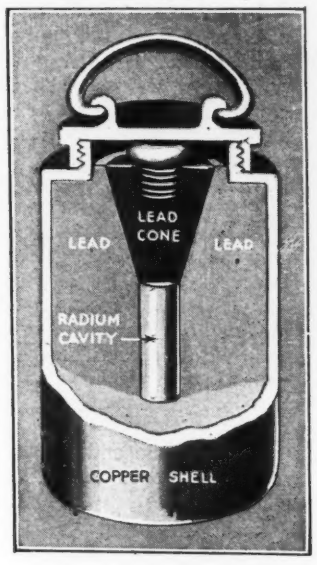


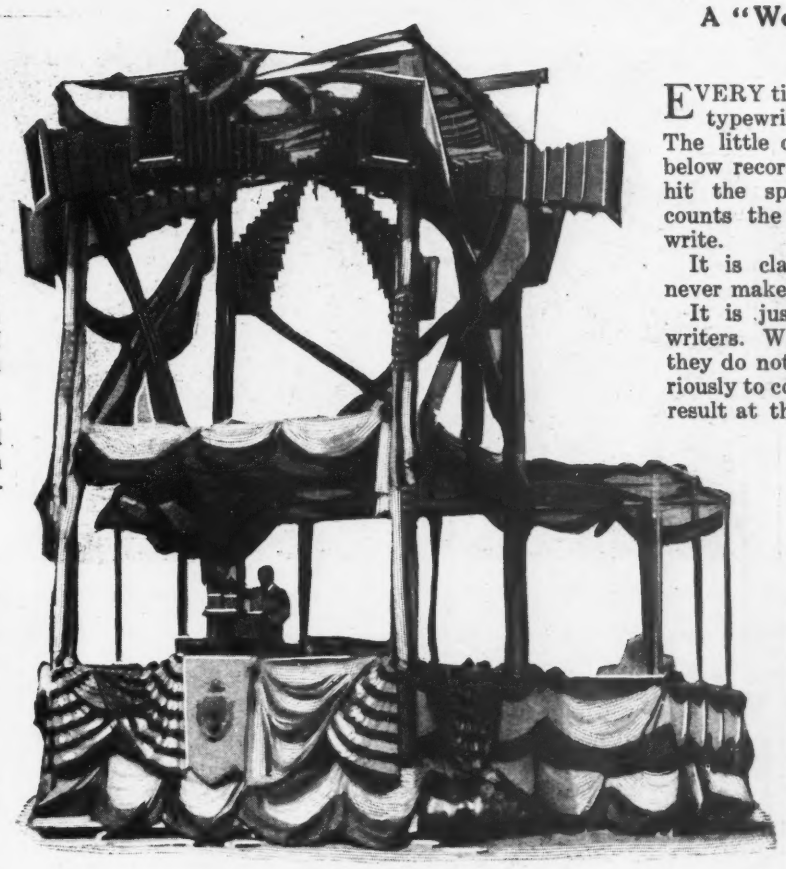
Don't Tremble; This Is Not a Bomb

NO, this is not a bomb, although it may look like one. It is a protective case used to transport radium.

The radium is placed in a hole in the center of a thick lead crucible. Why lead? Because lead does not permit the passage of the radium rays, and in this way the person in charge of the transportation of the substance is protected from injury.

Certain of the rays from radium produce a peculiar and dangerous burn, resembling an X-ray burn, which is practically incurable.





Hark to the Voice of the Thunder God

THE giant horns arranged around the top of this speaker's stand have loud-speaking telephone receivers at their small ends.

The voice of the speaker below is directed into a special transmitter. From this point it passes through an amplifying apparatus before it reaches the receivers at the top of the stand, where the articulation is flung far and wide to the great crowd.

In this way a single speaker can address as many as forty thousand people in a single gathering. The importance of this new device as an aid especially to politicians and other orators cannot be overestimated.

Abe Lincoln was satisfied to get upon a stump and address a few hundred people. But times have changed and present-day stump speakers demand huge audiences.

A "Wordometer" for the Typewriter

EVERY time you hit the space-bar on a typewriter you have written a word. The little counter shown in the picture below records the number of times you hit the space-bar, and in this way counts the number of words that you write.

It is claimed that the little device never makes a mistake.

It is just the thing for short-story writers. When they have finished a story, they do not have to go through it laboriously to count the words—they have the result at their elbow when the last word is written.

The "wordometer" is not foolproof, however. If the space-bar is manipulated for paragraphing, it will record the movements as words.

For the Canoeist—the Gun that Folds Up

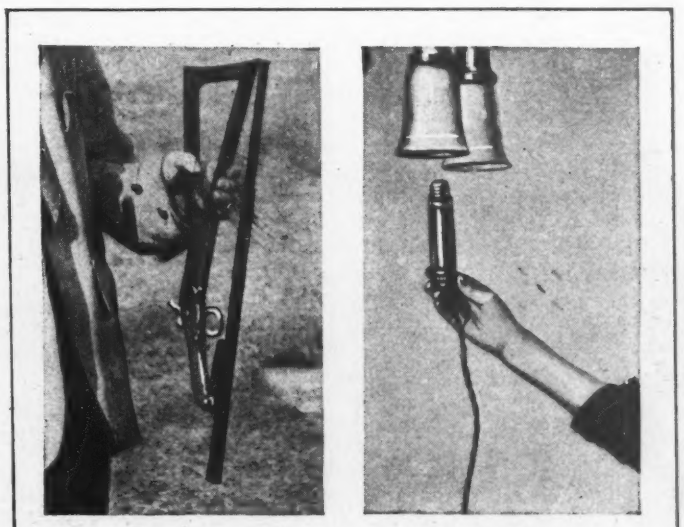
A SHOTGUN would be much easier to carry if it could be folded. And why not fold it? The picture shows one method of doing it.

The barrel and stock are hinged together and may be doubled up so that the muzzle rests against the butt-plate. The gun remains in a fixed position, however, unless a side lever is pressed.

You will notice at once that the stock of the gun has been hollowed out. This reduces the weight without weakening the weapon. The gun can be instantly swung into position when game is sighted.

It was invented by a canoeist who was in the habit of going on long cruises. He had already tried various kinds of shotguns, but had found them all unwieldy. The one he invented has a twenty-four-inch half-octagon-shaped barrel and it shoots a forty-four-caliber shot cartridge with surprising force and accuracy.

This new shotgun is entirely practical for small game or for miniature trap-shooting. The side lever that is used for folding the gun also controls the loading or extracting of shells.



This Electric-Light Plug Fills a Great Need

HAVE you ever tried to put an electric plug in the socket with a small glass shade attached to it?

If you have, you will certainly be able to appreciate the usefulness of this little device which has recently made its appearance on the market. It saves time and temper, and costs only a small amount of money.

It is one of those things that have been needed for a long time, but no one seemed to have the ambition or the inclination to manufacture it.

It is really an ordinary plug with an extension. It can be used in connection with an electric toaster, iron, motor, heater, or vacuum cleaner. In such cases, it can be attached to the cord after removing the old plug.

A few minutes' labor with a jackknife and a small screw-driver will provide you with this time-saver. Without it, it is oftentimes necessary to remove the light shade before the plug can be inserted. This is not only troublesome, but there seem to be few people who succeed in getting the shade back in its place before they drop and break it.

Four Legs for the Vacuum Bottle

SINCE nothing is to be gained by crying over spilt milk, care should be taken not to spill it at all. But if your milk is in a vacuum bottle, it is very apt to spill. That is why H. C. Downey, of Springfield, Ohio, has invented a stand for vacuum bottles.

The stand is a four-legged metal device which is fastened around a bottle with a leather strap. It can be adjusted to fit bottles of all sizes.

To drain the bottle, fasten it upside down in the stand.

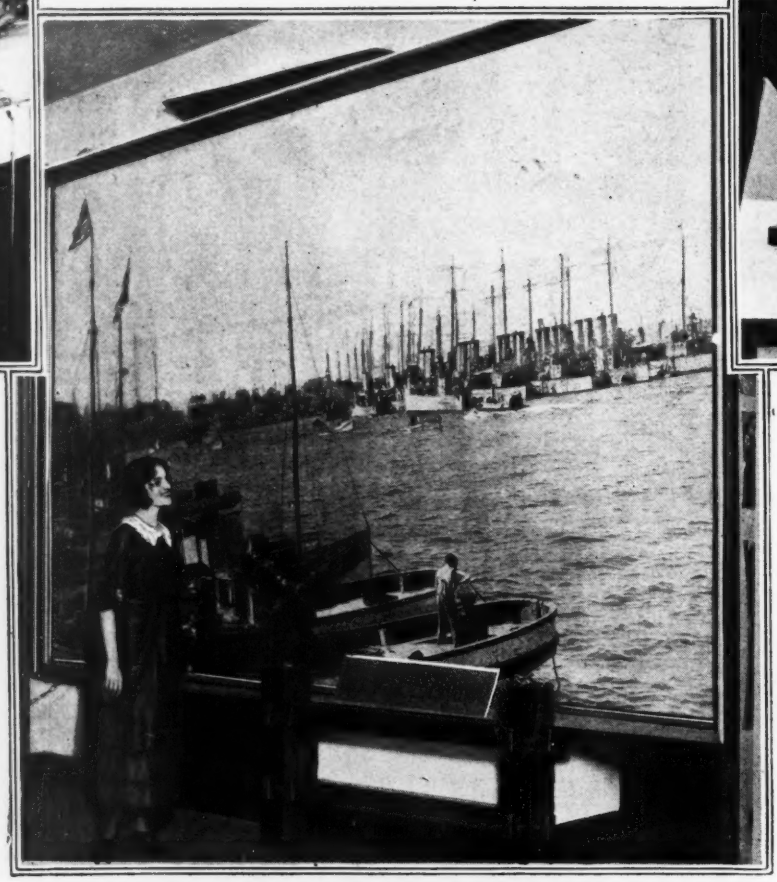
Such a stand as this will also be of inestimable value to campers, automobile parties, and fishermen.

Twine that Is Part Paper

A HARVESTER will start across a field of wheat and in a short time leave behind it a trail of wheat stalks bound neatly in sheaves. It clips them, stacks them, binds them, and drops off the finished bundles.

For the binding process the best quality of twine must be used. Twine that is rough and not sufficiently strong is very apt to hold up the whole job. But the best quality of twine is very expensive to-day and farmers do not like to pay for it.

Now, however, there is a machine for twisting paper into twine. The paper gives it the necessary smoothness without impairing its strength. For this purpose the rougher fibers may be used, and in consequence the twine made from it is cheap.



Huge Photographs for Movie Backgrounds

WHEN the fair heroine of a motion-picture looks out of her window in the play that is being screened, she may be looking at a giant photograph instead of at a real scene. It is often less trouble and expense to obtain a photographic enlargement from a small "still" negative than to travel a distance to get a suitable background, or to have a background painted.

Mr. Shipman, of Los Angeles, California, has devised a way to make huge enlargements from small films or plates. His method is not disclosed, but it is very successful, as can be seen by the illustration, which shows a girl standing beside one of the enlarged photographs. A brilliant source of light is required, unless a very sensitive emulsion is used, in making ordinary enlargements of great size.

Where's the "Old Man"?

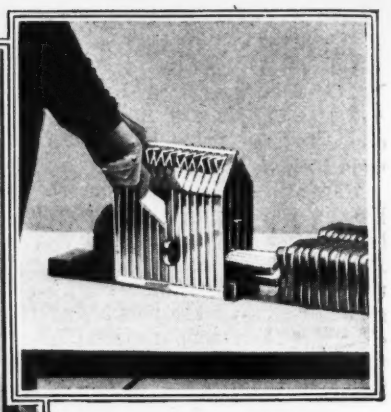
"THE superintendent's wanted on the 'phone!"

What's the best and quickest way to spread this news when the "old man" has lost himself in the factory?

In England signaling by lights is favored; it is more "refined" than the noise system used generally in American factories.

In an English factory, when Mr. Smith is wanted, a switch is turned on and a red light glows in all departments of the factory; other men have other colors.

The scope of ears, however, is greater than that of eyes. We can hear noises that come in all directions. If Mr. Smith is wanted, why not make a noise that is different from the general noise of the factory? Give him one ring; Mr. Jones, two rings; and so on.



Cutting Uniform Slices of Bread

IF you can slice a loaf of bread so that you don't end up with a triangular knob, then perhaps you don't need a bread-slicer. But most of us are not expert in the art of cutting bread.

It is for the inexpert that Mr. W. H. Garlock, of Seattle, Washington, has invented the breadslicer shown above.

It consists of a corrugated wooden base on which the bread stands. A metal cover fits over the base, and slots in it guide the knife as you cut.

By adjusting a stop at the end of the wooden base, you are able to vary the thickness of the slices.

The Gun that Shoots Gas

"HANDS up or I'll shoot!" You level your pistol at the astonished burglar. But suppose he failed to hold up his hands and made a dash for safety—would you really shoot him?

Most people are filled with horror at the thought of killing a human being; they would rather let him escape. And burglars take advantage of this.

But now there is a pistol that shoots a suffocating gas instead of a bullet. You aim it at the burglar, pull the trigger, and paralyze him completely for the time being. The gas is held in the handle under high pressure, and, when released by pressure on the trigger, will shoot.

The pistol was invented by a Frenchman named Trousson.

A Portable Kitchenette

TWO rooms and kitchenette—you pay dearly for that kitchenette these days. Why not supply your own? Here is one that comes in the form of a handsome cabinet, adding to the appearance of any dining-room.

When you open it—top and front—you find on the top shelf a fireless cooker and two plain cookers, all operated by electricity supplied from a regular house-plug.

A rheostat enables you to control the amount of heat that goes into the cookers.

Germany's Porcelain Money

GERMAN marks have so depreciated in value that the silver in them is practically worth more than the coins themselves.

In consequence of this, the Germans are considering the use of porcelain in future mark-making. A five-, a three-, and a two-mark porcelain coin, submitted to the German government, are shown above.

A porcelain factory in Meissen, which formerly manufactured beautiful vases and dinner-sets, has been making porcelain coins for the city itself, and has also on hand an order for three hundred thousand twenty-pfennig pieces for the railways of Hamburg.

This factory is perfectly well equipped to manufacture coins for the entire government.

The Hair-Cut Electrical

THE barbers' strike and the subsequent high cost of hair-cutting need not worry you if you can get an electric hair-cutter.

No great amount of skill is needed to operate the machine, and your wife could cut your hair for you.

Unfortunately, the machine was invented in Germany, and it may be hard to get.

Below are some German children having their hair clipped in the most up-to-date manner.

Making a Tiny Circus

MAKING a tiny circus, complete in every detail, is the hobby of Arthur Thorpe, of St. Louis, Missouri. He is shown below in the midst of some miniature animal wagons that he has already completed.

At present there are sixty of these pieces, but he intends to raise the number to eighty-five before the year 1921 is past.

He has made all the necessary tents. Besides the Big Top, there is a horse tent, three dressing-tents, a blacksmith shop, a cookhouse, and a dining-room.

The entire circus, from tents to sawdust, is located in a corner of Mr. Thorpe's back yard.

On the Trail of a Drill

DURING the war, the geophone, a listening instrument, made it possible for our men to determine the exact position of German mine-workers.

The instrument has been used in coal-mines for locating entombed miners. It can also be used for getting the exact location of a diamond bit when deep holes are drilled. When the bit has reached a depth of a few hundred feet, it is hard to tell whether it is following the exact path laid out for it. By using the geophone, however, it is possible to find all three dimensions of a bit with fair precision.

New York's Volcano

A FIRE that had all the earmarks of a volcano was raging recently in New York city. It erupted in some filled-in land near Van Cortlandt Park. Half burned coal and ashes were used as the filler and the accumulated gases underneath exploded.

In spite of heavy rains, the fire continued to burn for weeks, giving off strong sulphur fumes all the time, to the mystification and alarm of passers-by and near-by flat-dwellers. The newly laid sidewalks became red-hot and the fences were burned. The bed of coals burning fiercely gave off tremendous heat and made many a man with a coalless cellar very sad.

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Up to Its Tubs in Ice

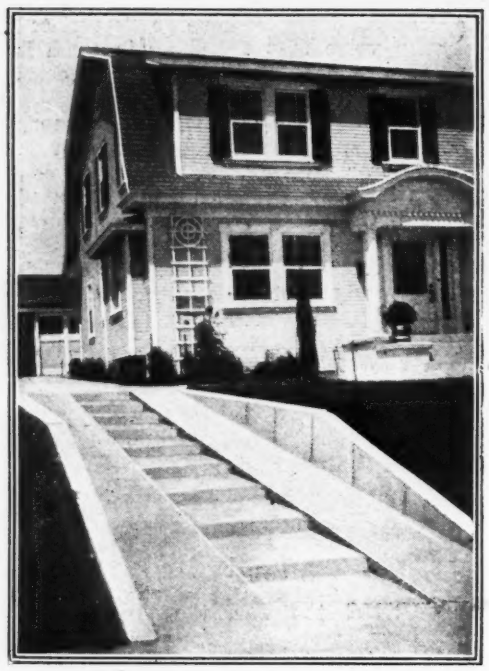
A STOVE almost completely submerged in ice is a strange sight. How would you feel if you visited your summer home in winter and found your stove in such a plight?

That was the experience of some people who had a cottage near Old Orchard Beach, Maine. The pipes had burst and the water flooded the entire first floor. Sofa-pillows, pots, pans, and various other household furnishings were caught in the flood and held fast in the ice, which was several feet thick.

From the appearance of the tubs, stove, dining-room chair and table in the picture above, the rooms look as if they were arranged for legless occupants.

Newspapers from Slot Machines

THERE is a certain exclusive suburb which does not approve of newsboys. They're too noisy, you know—might disturb the baby or the cat. So the exclusive residents buy their papers from slot machines placed on various corners. The required number of pennies are dropped into a slot at the side of the particular paper wanted, as is shown below. This action releases a crank and the paper drops through an opening in the bottom. When a paper is sold out, a sign tells you so. If you haven't the correct change, the machine will make it for you.



Combining the Driveway with the Walk

ONCE a Los Angeles man bought a new Colonial house with a small garage at the rear. There was neither a driveway leading to the garage nor steps leading to the house entrance. The house was so new that only the lawn in front had been finished.

It was up to the owner to finish the job. But labor and building materials were costly, the owner was not a rich man, and he had already spent several thousand dollars on the venture.

So he developed an entirely new scheme. He built his driveway and sidewalk together, putting a flight of short steps, two and one half feet wide, between the driveway strips, making the whole a solid piece of cement work. At each side he built a retaining wall to hold the lawn earth in place.

At the top of the steps a narrow walk branches off, leading to the front porch of the house.

The general scheme is decidedly effective, and the owner says he saved considerable money in labor and material by building in combination rather than by putting in a separate driveway and walk. A picture of this driveway with steps in place of the usual grass strip is shown above.

Buy a Tree and Save a Forest

"DO your share to preserve our forests," says Mr. A. Kraft, of Oakland, California. And then he tells one way to do it—by using the combination Christmas tree, hat-rack, and clothes-rack that he has invented. Just one tree-trunk is needed for all three and it may be used for years.

Several small holes are bored in it. When you use it as a hat-rack, you put short pegs in these holes. On washday you take the short pegs out, put in long ones, and hang your wet clothes on them. When Christmas comes round, you "procure" some pine branches from somewhere and fit them in the holes. One tree, only, need be sacrificed for all your household hanging operations.

A Shoe-Shine in Your Vanity Bag

FIRST aid to dusty shoes may now be found in vanity bags. Possessed of such aid, a woman, after crossing a dusty road, presses a button at the side of her vanity bag and out jumps a felt pad at the end of a wire spring. By bending over slightly she is able to brush off her shoes, and proceed on her way reshined. She compresses the spring of the pad-in-the-box and tucks it out of sight.

"Where are these dusty roads?" you ask. In England; the invention is an English one. But it will undoubtedly find its way to this country.

A Little Scent Sweetens All the Air

HERE is a deodorizer designed to hang on the wall. In it is placed a sweet-smelling volatile liquid that continually evaporates, filling the air of the room with a pleasant odor. The liquid lasts for several days. When it is exhausted, the supply can be replenished from a bottle furnished with the deodorizer. A stopper placed in the opening will prevent evaporation if the room gets too "sweet."

When the housewife is cooking cabbage or when Limburger cheese is on the menu, this device will be more than welcome. A New-Yorker who uses the subways during the rush hours suggests using deodorizers as a means of making travel more comfortable.

He Made His Own Stop-Watch

SWIMMING champion C. J. Cooke, of Washington, D. C., wished to time his daily swims in order to see how his speed improved. But nearly every time he swam, there was no one around to hold a stop-watch. He couldn't very well take it with him, so he invented a clock that would serve his purpose.

He took an old alarm-clock, removed the spindle that held the wheel opposite the escapement wheel, and put in its place a much longer spindle. The wheel's revolution speed was thus changed and the minute-hand became a second-hand. He noted the time when he plunged into the water, and again when he came out of it, thus keeping his own time.

Here's a Duplex Book

"A LEVER is shown at *A* in diagram 7." When you read it, you start looking through the book for diagram 7. It may or it may not be on the same page. How much simpler it would be if diagrams and reading matter were always in front of you at the same time.

In the new double book shown below, invented by a German engineer, this is the case. The pictures and diagrams are in a book by themselves.

This book, together with the book of reading matter, fold inward and become one when not in use.

This Beautiful Arch Is Made of Bamboo Trees

THE Botanical Gardens in Rio de Janeiro are the finest in the world. Not only are they very beautiful, but in them there are many strange growths of great interest to scientists.

Among these interesting phenomena is a remarkable arch of bamboos. The trees grew so rapidly that they were unable to stand erect and they bent over in the form of an arch.

Just beneath this arch of bamboos there is a bubbling brook with a path at its edge. It is a charming spot, and is visited and enjoyed by people from all over the world.

There is another famous arch in the Rio de Janeiro gardens. It is formed by two rows of enormous palms that bend toward each other at a height of one hundred feet.

Chess-Playing by Wireless

CHESS-PLAYERS aren't the least bit sociable. If one were in Berlin and the other in The Hague, they could conduct their game just as well, provided that each knew the other's moves.

By means of a new device, two champion players tried this recently. A piano keyboard with white and black notes, representing the squares on the chessboard, was connected with a wireless sending station in each city. By pressing down a key that corresponded with a certain move, a wireless signal was given, and this was sent on to the player in the other city.

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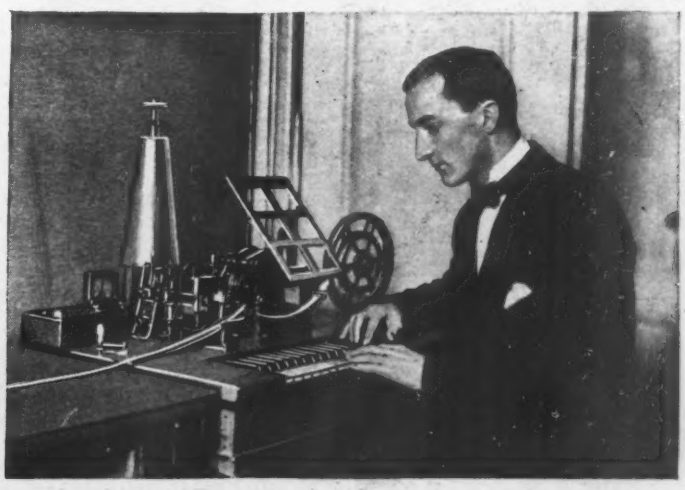

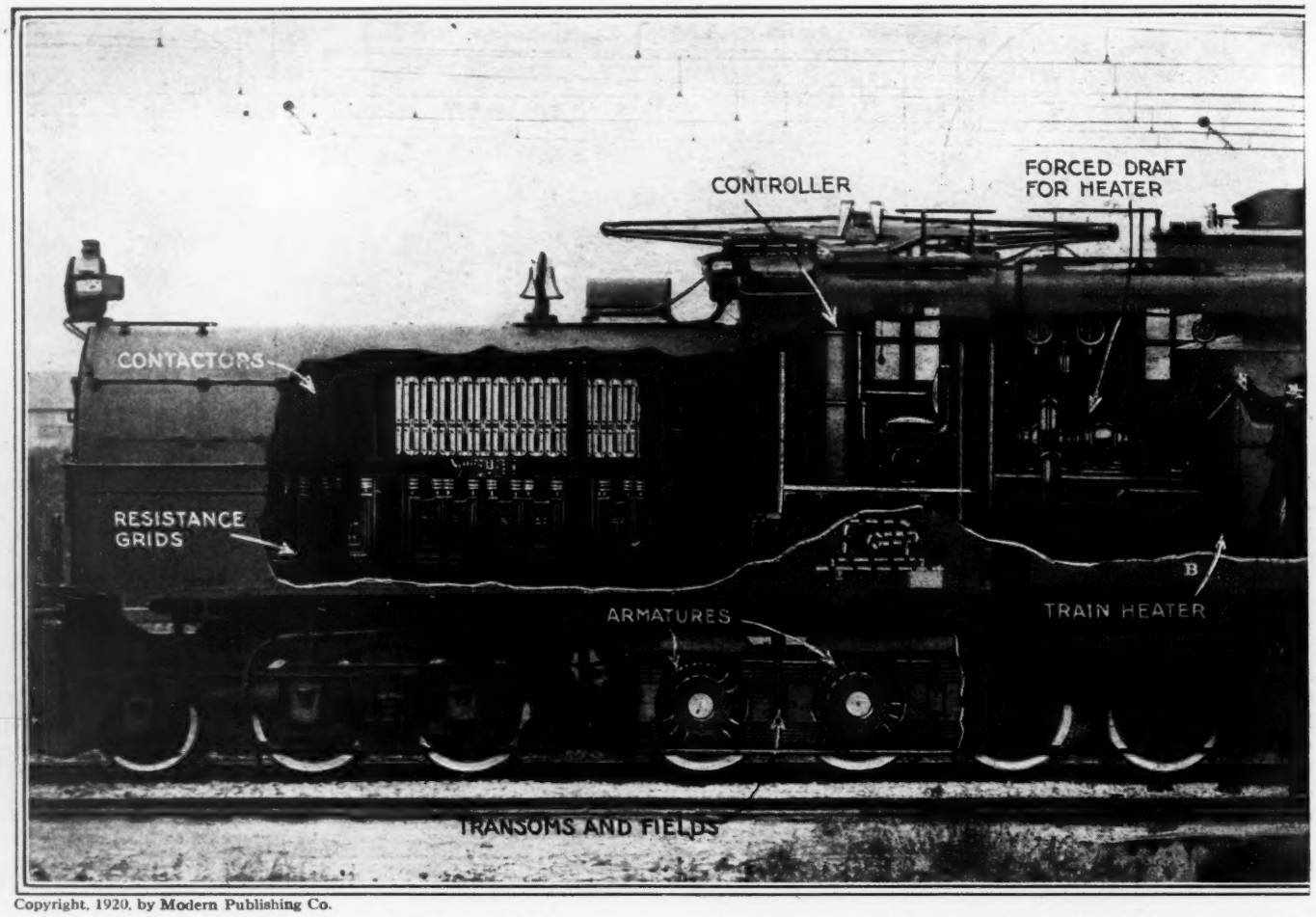

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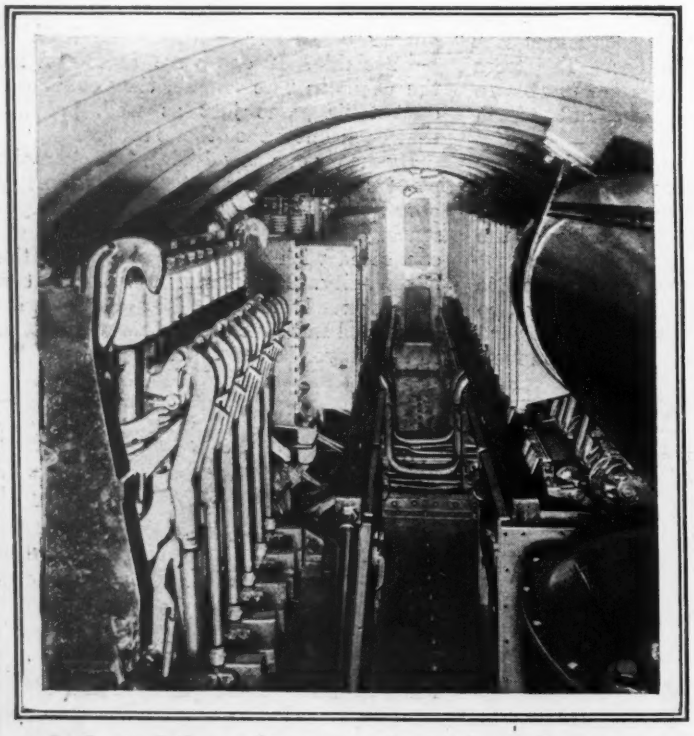
Like a trolley-car this huge electric locomotive, which hauls trains over the Cascade and the Rocky mountains on the Chicago, Milwaukee & St. Paul Railway, can be controlled from either end. Hence turntables are not required at division points



In front of the engineer, at each end, is an "apparatus cab," filled with resistance coils, through which passes the 3000-volt current, controlled from the engineer's levers through solenoid switches. The front section, or "apparatus cab," is closed when the engine is running. If a man were thrown against the coils while the engine is rounding a curve, he might be killed. The central passage accommodates a man, who can make repairs when the locomotive is idle

The electric locomotive needs no tender filled with fuel. It can run one thousand miles without overhauling; for there are no ashes to dump, no flues to clean, no boilers to inspect. Its horsepower is about 3500, so that it does the work of four steam locomotives

Over the Rockies

THE steam-locomotive boilers of the country generate, all told, 50,000,000 horsepower. One quarter of all the coal mined in the United States is thus consumed. This total horsepower is just about equal to the water-power that is going to waste. Hence, if water-power were used to operate railways, 150,000,000 tons of coal would be saved annually, and an army of mine and railroad workers would be released for other employment.

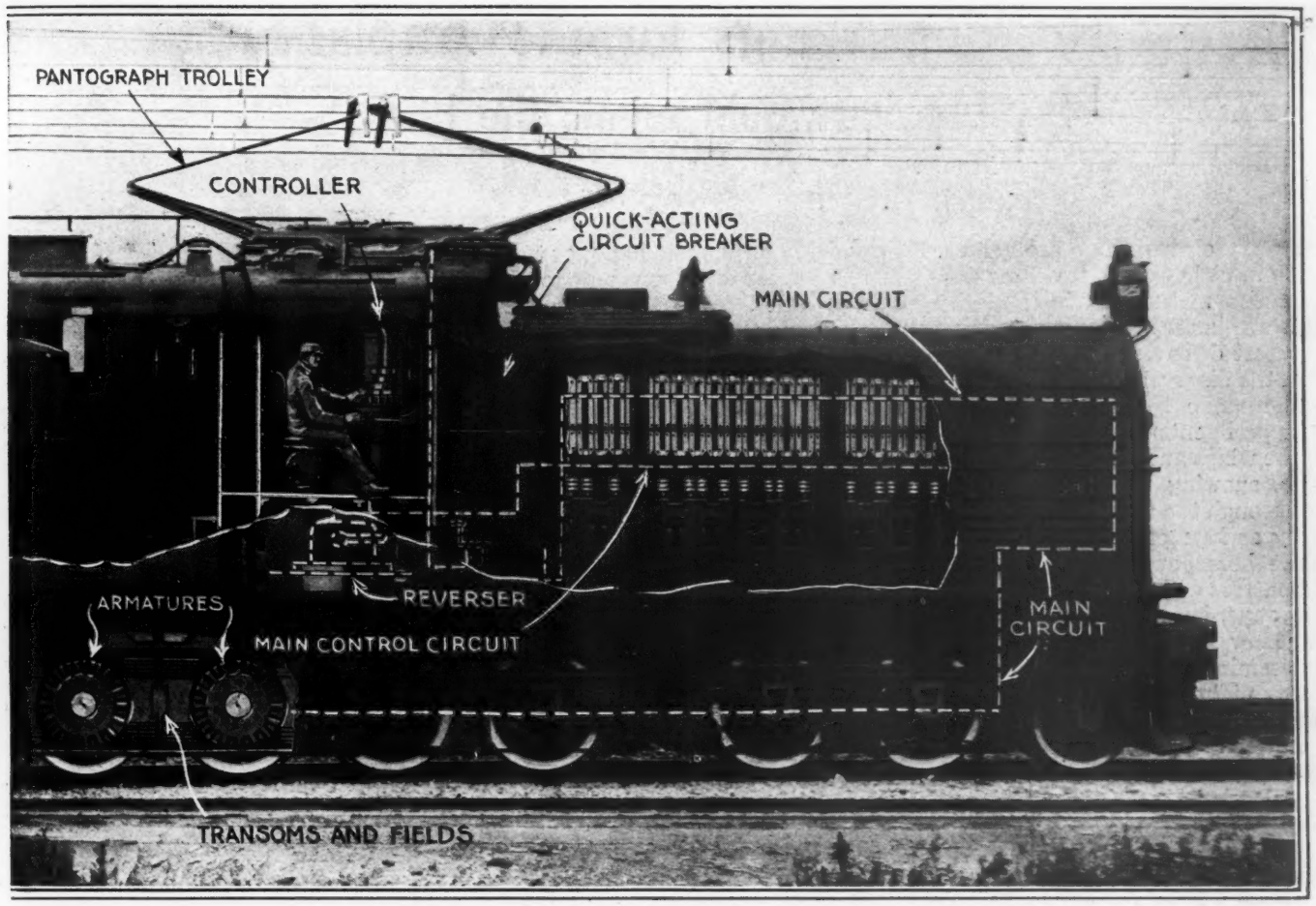
Despite these well known facts, the electrification of our railroads has been a slow process, due chiefly to the fact that the problem of substituting electricity for steam involves not merely the employment of another kind of locomotive, but the adoption of a fundamentally different method of train propulsion.

Railroad electrification has received an enormous impetus now that the Chicago, Milwaukee & St. Paul system has banished steam entirely from its Pacific coast division. The total electrified main-line trackage is 700 miles, so that the United States becomes the possessor of the longest electric railway in the world. The road extends from Harlowton, Montana, to the Pacific coast, crossing on its way two mighty mountain ranges, the Rockies and the Cascades.

Fifteen water-power stations make available a combined electric horsepower of 410,000, so that, in a sense, you are carried by a waterfall as you travel over the mountains.

Electric operation has reduced by twenty-two and one half per cent the number of trains and by twenty-four and one half per cent the average time per train. It has improved operating conditions, so that nearly thirty per cent more tonnage can be handled electrically in eighty per cent of the time formerly needed to handle the lesser tonnage by steam-engines. The capacity of the road has been thus increased about fifty per cent.

Of the locomotives that have made these marvels possible fifty-one were designed and built for the Chicago, Milwaukee & St. Paul railway by the General Electric Company. There are sixty-one of them all told, including passenger, freight, and switching engines. They have released for service no



It hauls a 960-ton, twelve-car passenger-train on a two per cent grade at twenty-five miles an hour; the steam locomotive would make only twelve miles. On the level, the electrically hauled train makes an average speed of sixty miles an hour

The over-all length of the locomotive is 76 feet, its total weight 260 tons. Between the leading 3-axle trucks at each end are two 8-wheel driving-trucks. The train hauled by the locomotive is heated not electrically but by steam from an oil-fired boiler

on a Waterfall

fewer than 162 steam-engines and have effected an annual saving of 300,000 tons of coal and of 40,000,000 gallons of fuel oil.

The electric locomotive takes its current from an overhead wire like a trolley-car, not with the usual pole and wheel, but with an ingenious double trolley, called a "pantograph" after the drafting instrument of the same name. The pantograph always insures perfect contact. The locomotive never "gets off the trolley."

Current at 3000 volts—the highest direct-current voltage employed in railway work anywhere—is taken from an overhead wire. But the huge electric locomotive must not be regarded as a magnified trolley-car. It embodies so many new ideas, both in railroading and electrical engineering, that it marks a new epoch in transportation and in locomotive building.

The low-tension currents used on a street-car (600 volts) can be handled directly by the "controller" of the motorman. But in the case of this 3000-volt current the controller in the engineer's compartment operates certain "banks" of electromagnetic switches (solenoid switches), and these in turn feed the current to the motors.

The electric locomotive returns power on the down grades. The speed slackens. The motors (not the brakes—for they are not needed) assert their control. The grade becomes steeper. As the engineer scans the dial before him, he sees the trembling pointer slowly reverse its motion—creep, point by point, in the opposite direction. The motors, now converted into generators, are giving back current to the power line! The air-brakes are used only to stop the train at stations and in emergencies.

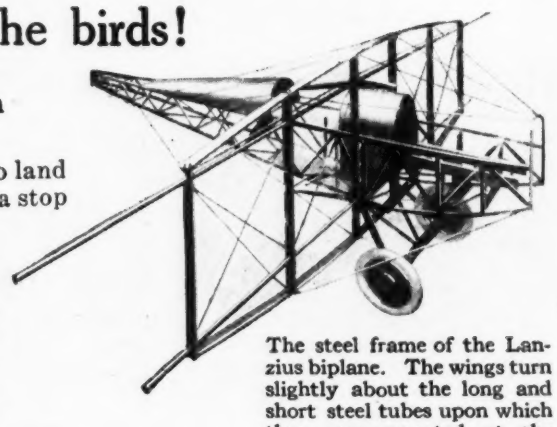
"Regenerative braking," as it is called, is not electric braking. It is electric speed control. The motors on the down grade produce an electric current when the armatures are revolved, and the recovered current is restored either to the railway's power line or to the power company's transmission line. In the latter case, the restored current automatically sets back the power company's meters and credits the railway with the amount of the regenerated current. Electricity keeps its own books!

From the overhead wire the electric current passes to the engineer's control levers. A glimpse of the interior seems bewildering, with its ammeters, gages, and speed-indicators. Compared with the devices required to convey the 3000-volt direct current to the motors, the "controller" of an ordinary trolley-car is as a safety-pin to a watch for complexity. Yet, to the engineer who presides over the "solenoid switches," through which the current is relayed to the motors, all this is like reading a thermometer

Rocking Wings for the Airplane

So, Lanzius would mimic the birds!

By Stanley Yale Beach



The steel frame of the Lanzius biplane. The wings turn slightly about the long and short steel tubes upon which they are mounted at the center of pressure

INSTEAD of traveling around the earth in eighty days, it will be possible soon to make the trip in eighty hours if airplanes are built according to the latest discovery. The practical result of the discovery that F. Handley Page has made by means of wind-tunnel experiments concerns the "aerofoils," the wings and air-surfaces of the machine, showing that these can be driven through the air more than twice as easily as heretofore with only one third the horsepower.

An albatross will soar along behind a ship for days, hardly ever flapping its wings. How it manages to find support in seemingly still air and keep up its gliding flight is an unsolved secret that the Association Française Aérienne is assiduously trying to discover.

In the Early Days

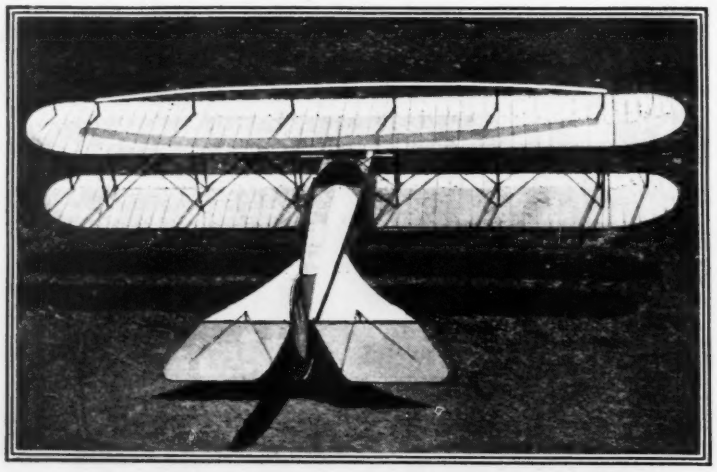
The Wright brothers performed their first glides at Kitty Hawk, North Carolina, in a stiff breeze that was blowing up their inclined surfaces—a veritable sliding downhill on the air. Finally they made a motor sufficiently light and powerful to push the machine fast enough against the wind to keep it in the air and at the same time drive it forward over the ground. Instead of sliding downhill and gradually losing elevation, as it did when gravity was propelling it, the method of flight was reversed and the planes or wings (aerofoils)—set at an angle of seven or eight degrees—tended to run up an incline on the air.

As this inclined plane of air was not solid, it was constantly pushed down as the machine passed over it, and the latter followed a horizontal course. By depressing the tail, the angle of the wings became greater, causing the lift to increase and the machine to ascend an inclined plane of air.

The power of the motor is exerted through the propellers to overcome the head resistance, or "drift," of the machine and its wings, and hence to push or pull it forward against the wind.

When the angle of the wings with the horizontal is reduced, the head resistance becomes less and the machine flies faster. In starting and alighting, an angle of ten degrees or so develops a great lift as well as big head resistance, and causes the machine to take off quickly on the one hand, or to land at a low speed and soon come to a stop on the other. When in flight, by reducing the angle to two or three degrees, the drift drops off and the speed increases rapidly. Instead of the power required to drive increasing as the square of the speed, the latter may be very appreciably increased with the same horsepower.

This may be one solution of the Handley Page discovery. At any rate, its value has been demonstrated by the airplane of George Lanzius, of New York, who built during the war several machines which the United States government failed to use. Equipped with a 400-horsepower Liberty motor, a 34-foot-spread biplane of this type took off with a two-degree angle merely in a run of but 500 feet, and kept steadily rising as it traveled faster and faster on a straight course. It covered two and one half miles in thirty-five seconds. This without using the increased angle of incidence to start.



The Lanzius biplane, whose wings rock upon steel tubes passing through their ribs, thus changing the angle at which the wings are directed in flight. High speed can be obtained with low horsepower when the angle of incidence is small

Varying the Angle of the Planes

By an ingenious arrangement, the angle of the planes of the Lanzius machine may be easily varied in flight. It may be reduced to zero degrees, and even be made slightly negative. In this way the head resistance may be progressively reduced and the speed increased. With higher speed, less area of supporting surface is required in the wings.

There have been a number of schemes to reduce the area in flight, but none have been operated successfully to date, so far as the writer knows. Professor Langley always maintained that the law of the square of the speed did not hold, and that the higher the speed and less the angle, the less the horsepower required, or that with the same horsepower one could fly at tremendous speeds.

Other Experiments

Henry A. House, who performed the Maxim experiments in England twenty-four years ago, agrees with him, and maintains that if a plane falling to earth from a great height develops a speed of three hundred miles an hour or more under the pull of gravity, it is also possible to make it do this horizontally when pulled by a propeller. The latter will have to be of the variable-pitch type to cause it to pull constantly at continually increasing speed, but by seeking high altitudes where the air is lighter—at 33,000 feet it is about one half the density—the head resistance is so cut down that extremely high speeds are possible.

Experiment has shown that the shape of the engine is highly important as regards head resistance, as is also the proper pointing and streamlining of the nose of the body. For great elevations an airtight body resembling a submarine will be used, in which the pressure will be kept at atmospheric. This will contain the engines as well as the people.

Mr. Lanzius has designed such a craft with many sets of his variable-angle planes on each side. It is a veritable air leviathan, capable of flying around the earth in eighty hours instead of in the eighty days required by Jules Verne.

Thirteen Billion Suns—Living and Dead

How astronomers measure the universe

By Abbé Théodore Moreux
Director of the Observatory of Bourges, France

When You Look at the Stars

From the days of the ancient Chaldeans, astronomers have wondered not only how many stars there are, but what is the underlying plan of distribution.

Abbé Moreux takes up these two questions in this article. He is not only a practical astronomer (he is the director of the Observatory of Bourges, in France), but he is one of the great French popularizers of science.

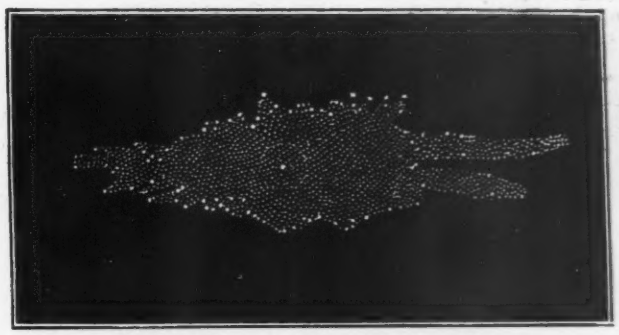
The astronomer Proctor placed the sun in the center of the great galactic circle

LOOK at the sky on a moonless night. There arches the Milky Way, a broad, phosphorescent ribbon that encircles the whole sky. In the telescope it appears as an accumulation of stars that defies our imagination. But, even with the naked eye, it is easy to distinguish what seems to have escaped the ancients—that the number of stars in the heavens increases as we approach the Milky Way.

Sir William Herschel, the first astronomer to make use of truly powerful telescopes, capable of grasping the light of the fainter stars, found the Milky Way literally composed of clouds of stars. He wondered what might be the sun's relation to such a vast assemblage of stars. He believed that we were placed in the middle of a universe shaped like a disk.

Through the effect of perspective, these stars in the disk appear to be in greater number if we observe them diametrically across the plane of the disk. As our eyes turn in a direction away from the plane, the stars diminish in number. The whole seemingly fantastic conglomeration is what we call the universe, and it is composed of about one billion stars, all suns like ours, and all in a stage of evolution that is more or less advanced.

In addition to the stars that seem to crowd around the plane of the Milky Way, telescopes show other objects no less interesting. Globular swarms of stars and strange, misty shapes which we call nebulae are also found near the plane of the galaxy. Do they form part of our universe? That question confronted scientists for more than two centuries—and still confronts them.

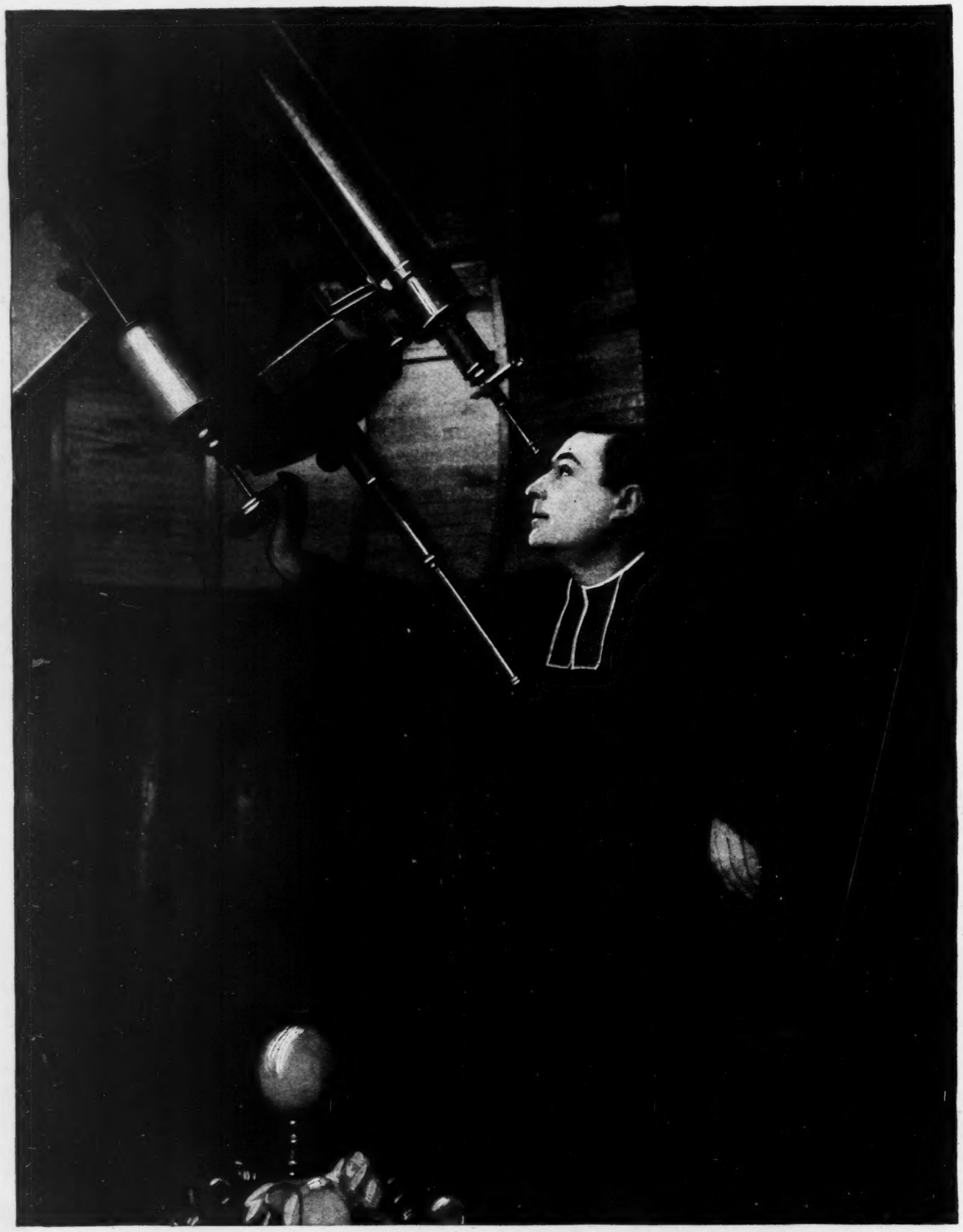


Sir William Herschel decided that this was the shape of the universe, the sun occupying a place in the great assemblage of stars

A chart showing the distribution of stars, clusters, and nebulae in the universe. The large dots remote from the Milky Way represent the spiral nebulae

At the time of Herschel, nebulae, like star clusters, were considered too distant to be defined into separate points by the existing telescopes. Both were thought to be masses of stars like the Milky Way. As telescopic power was increased, many of these misty objects were seen to be composed of myriads of stars, and this led to the conclusion that perhaps all nebulae were thus constituted. Thus originated the fantastic theory that these bodies were other universes, or "cosmic islands" in the vast ocean of space.

But in 1864 it was discovered that a large number of the so-called nebulae were gaseous bodies, vast masses of material destined to form worlds. This induced astronomers to adhere to their original theory that the nebulae belonged to our universe. But as the number of these misty patches of light increased as more powerful telescopes were used, it was found that the greater mass of them seemed to be collected at the points of the heavens remote from the Milky Way. The stellar clusters, however, were found in the regions near the plane of the galaxy.



The Abbé Moreux, Theologian and Scientist

Abbé Théodore Moreux, director of the Observatory of Bourges, France, early became interested in the stars. Though he is best known as an astronomer, he is also distinguished as a geologist, a chemist, a mathematician, a physiologist, and a physician. With all this profound knowledge, he is yet simple and modest.

He was one of the first scientists to conclude that the sun is the great weather-maker of the earth, and that solar disturbances are directly connected with the earth's cataclysms. He predicted the great earthquake that devastated the region about San Francisco, and has since made other important predictions. His early investigations disclosed many strange facts about sunspots, those gigantic disturbances that are known to affect the earth's magnetism.

He tells us that the universe is vastly greater than was imagined by the ancients. "We know," he says, "that among the bright stars are many that are comparatively dark. These semi-extinct suns, in the dark cemetery of space, counted with the estimated number of bright stars, provide a grand total of twelve or thirteen billions of living and dead suns."

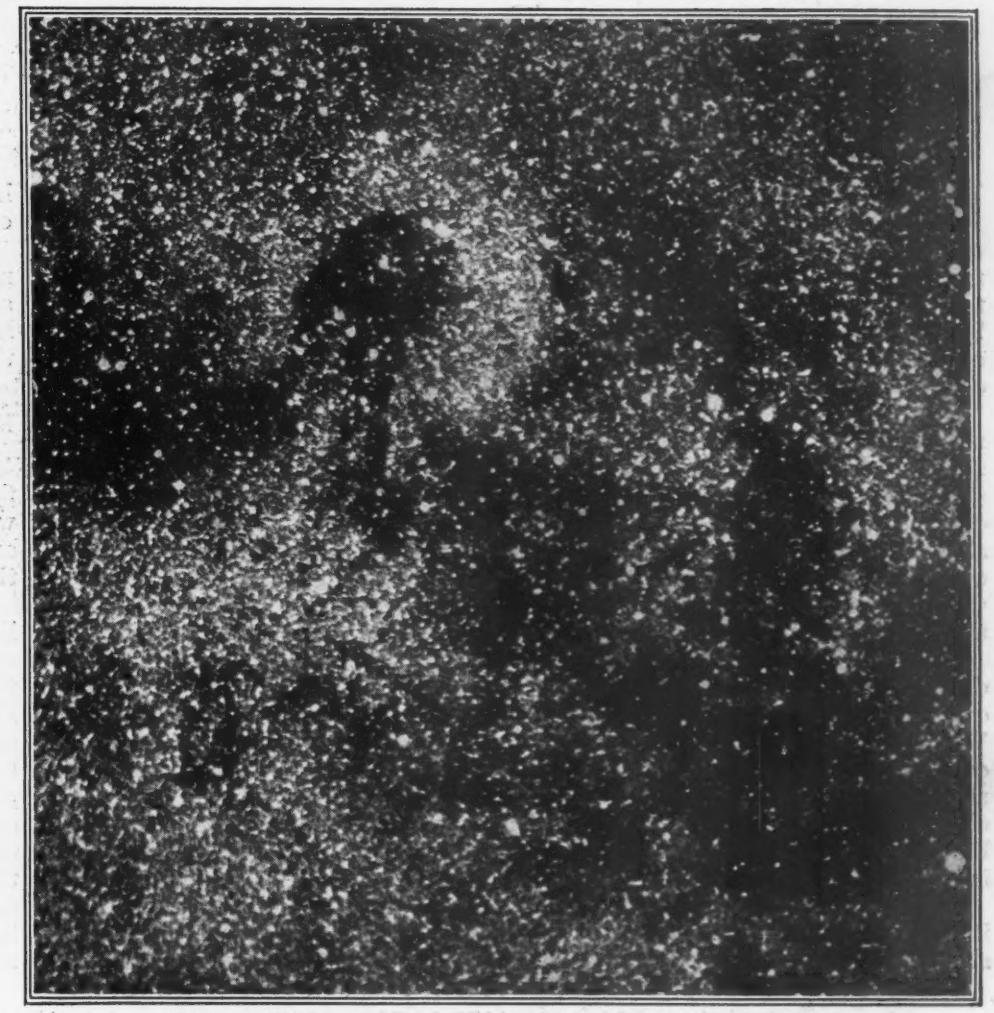
The relations of the star clusters and nebulae to the Milky Way become evident by their distribution in space. The mystery seemed to clear away when rough estimates showed that some of the nebulae, like that of Andromeda, were nearer to us than the most distant stars.

According to Simon Newcomb, the eminent American astronomer, the disk in the midst of which we are placed is so enormous that light rays have to travel from ten thousand to fourteen thousand years to traverse its diameter, traveling at the rate of 186,000 miles a second!

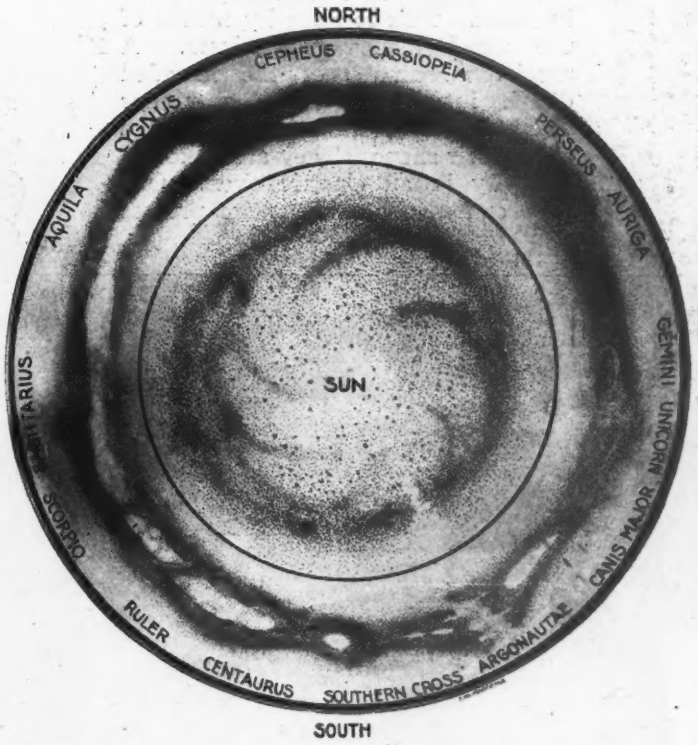
The spectroscope, an instrument that spreads the light of a bright body into a ribbon of color, was then invented. Not only did it permit us to analyze the substances that glowed in the stars, but it indicated in which direction the stars were moving in our line of sight. Light, somewhat like sound, travels in "waves," or oscillations. When the body emitting the light is coming toward us, the waves are crowded toward the blue end of the spectrum. When it is going away from us, the waves are drawn out toward the red end. The effect is illustrated in the approach of a swift automobile when a continuous blast of its horn is sounded. The pitch rapidly rises until the automobile passes, then the pitch falls. The short sound-waves of high pitch correspond to the short blue waves of light. This is called "Doppler's principle."

Measuring the amount of change in the spectrum of a star, its speed of approach or recession can be determined. The ancients considered the stars as "fixed" in space! Their average rate of motion is 22.5 miles a second. But there are some stars, such as the bright Arcturus, whose motion is greater than a hundred miles a second. The power of attraction of all the stars in our universe would not be sufficient to account for so high a rate of motion. That being so, whence came these stars? If they came from other universes beyond, then the old astronomers must have been right.

The nebulae farthest from the Milky Way are of a spiral form, somewhat resembling a burning pinwheel. More than half a million nebulae have been disclosed by photography, and many of these curious masses are traveling through space at a speed equal to that of the stars. This would give new weight to the theory of cosmic islands. Our own galaxy probably resembles these spiral nebulae as seen from remote regions. The sun occupies a place comparatively near its center. The speed of our "cosmic isle" is 1040 miles a second!



A rich region of stars in the Milky Way. Dark rifts stretch across the glittering background in a singular and perplexing manner



Abbé Moreux places the sun near the center of the great star masses. In the margin can be seen the constellations through which the galaxy extends in its gigantic circle around the heavens

Recently Dr. Shapley, of Mt. Wilson Observatory, has measured the distances of clusters and nebulae, and has shown that these mysterious objects are farther away than the Milky Way. The nearest star cluster is at a distance of 20,000 light years, and the most distant more than 200,000.

From these recent discoveries we find that we must expand by a vast degree our former estimate of the size of the Milky Way, which the astronomers of the nineteenth century had enclosed in too tight a circle. According to modern conception, the sidereal universe forms an enormous sphere 300,000 light years in diameter. The poles of this sphere are occupied by the spiral nebulae. The equator is occupied by the disk containing the stars, around which are massed the star clusters—our solar system among them, about 60,000 light years from that gigantic formation.

Bread without Flour

The grain, robbed of its husk, is made directly into dough

By **Dr. Alfred Gradenwitz**

BREAD has been the staff of life for thousands of years, as the Bible testifies. But in the passage of centuries no one has attempted to change the general process of bread-making. The grain has been ground to flour and the flour has then been turned into dough.

This intermediate flour stage is unnecessary, says Mr. Gross, a German scientist, whereupon he brings forth a new and startling bread-making process which entirely eliminates the flour stage. And what is more, the dough contains the valuable albuminous matter found in the bran without containing the indigestible cellulose husks.

Goats are the only animals that can digest cellulose; that's why they'll eat everything from newspapers to nuts. When a human being eats bread which contains these cellulose husks—and most bread does—he is trying to do as the goats do. He fails to digest them, however, and as a result his system is irritated.

And now for the huskless process itself. The grains encased in their thin shells are dropped into a trough containing hot water and are given a strenuous shaking for about half an hour. By this time the shells, or husks, have been detached from their grains and are ready for separation. Whereupon the entire contents of the shaking-trough are dumped into a reservoir containing a continuous supply of clear cold water. The heavier grains and albuminous matter drop to the bottom, while the indigestible husks and all impurities float on the surface, forming a dark layer.

Compressed air is turned on. It stirs up the husks with such violence that they are carried away by the ever moving water. At the end of ten minutes they have completely disappeared and the grains can be seen at the bottom of the reservoir through the transparent water.

How the Grain Becomes Dough

A trapdoor in the bottom is released and the grains drop on a rolling-mill below. They pass over a series of granite rolls and are crushed till they form a fine homogeneous dough, ready to be made into bread. Salt, leaven, and water (if necessary), are added to the dough. But in most cases the grains have absorbed enough water in the husking process to make the addition of water unnecessary.

The dough is now ready to be kneaded. This is done by means of the usual mechanical mixers. A special machine cuts the kneaded dough into pieces of the proper weight, and a molding-machine gives them their shape. They are baked in quantity in an electric oven. One man can manage this entire process himself; in fact, one man can take care of a large-sized plant.

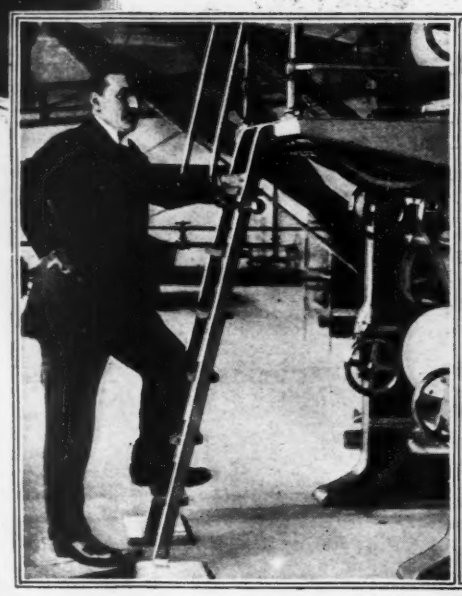
The loaves of bread made by this method look just like ordinary loaves, as is shown by the picture to the left. But your digestive system will know the difference.

It Took Twenty Years to Perfect

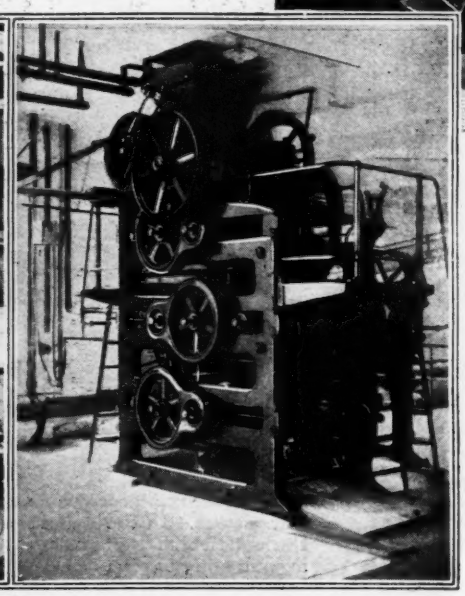
Mr. Gross, the inventor of this flourless process, spent twenty years working on it before he perfected it, and the results have been even better than he expected.

Not only is the bread highly digestible, but a greater quantity of it can be made from a certain amount of grain than can be made by the old process. From one hundred pounds of grain one hundred and forty pounds of bread can be made by the Gross process; whereas only one hundred and eight pounds can be produced by the usual grinding process. And the time of dough-making is greatly reduced. Half an hour after the grain is dumped into the shaking-trough it emerges in the form of dough.

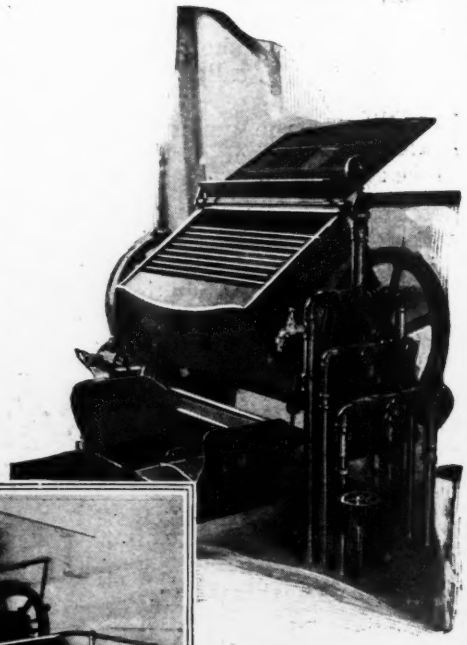
A special machine cuts the kneaded dough into pieces of uniform weight. Another machine molds them and, when baked, they are all of the same size, a method followed by most bakeries



This is Mr. Gross, the German who invented the new method of handling grain. He spent twenty years working on the process before he perfected it



The huskless grains are crushed through a series of granite rolls (shown here), coming out at the bottom in the form of a fine dough, ready for use



This husk-removing machine consists of a shaking-trough and a cleansing reservoir. The trough is filled with hot water and the grains are thrown in shaking loose the husks

Sharpening Drills by Machine

THIS compressed-air forge is capable of doing the work of several blacksmiths and their helpers.

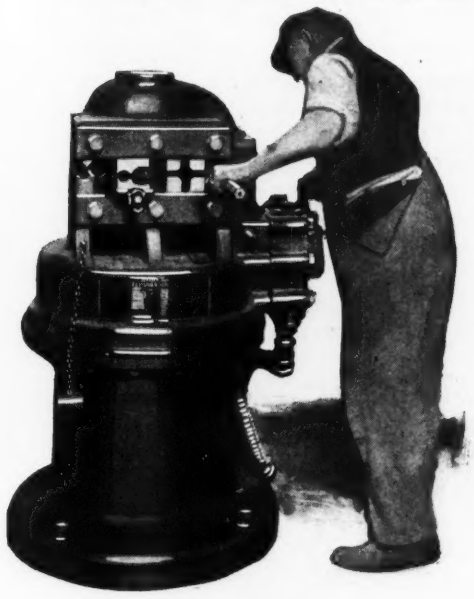
The new machine is largely used in sharpening bits used in rock drilling. A short time ago this work was done by hand. Where large excavations or tunnels were being made, several blacksmiths had to be on hand to keep the bits sharp. One man and one machine now sharpen the bits as fast as they are dulled.

The bit is heated in the forge and placed under the plunger of the compressed-air machine. A blast of air under high pressure forces the plunger down to reform the business end of the bit.

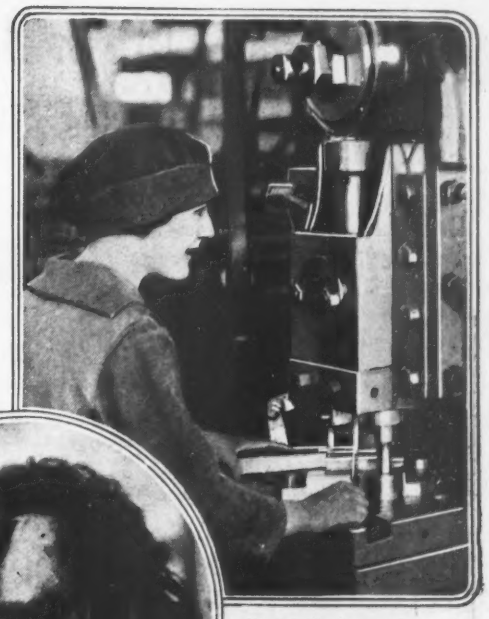
The drill ends can be sharpened with this machine as fast as they are heated in the forge.

With one man watching the forge and another feeding the machine, the work of seven or eight blacksmiths can be performed.

Where extensive excavations are being made, there is always an abundant supply of compressed air to operate the sharpening machine.



This is a compressed-air drill-sharpener. By its use two men can do the work of eight blacksmiths. It eliminates the clumsy old-time forge



It is obvious that the cap worn by the girl above is both sanitary and a precaution against accident to her long hair

This girl's hair was caught in a machine and pulled out by the roots because she wore no cap while working at her machine

Safety Caps Protect Factory Workers

MANY of the thousands of women who went into factory work during the war are remaining because of the good wages.

One look at the picture above will explain why some form of cap is necessary for every woman factory-worker. The girl in the lower picture did not wear her cap. As a result a handful of her hair was torn out by the roots. If she had worn her cap, she would have saved her hair and avoided much pain.

Yet the usual cap is uncomfortable, hot, makes the hair fall out or turn gray, and causes severe headaches.

To overcome these disadvantages, a self-ventilating cap has been devised. It weighs only one quarter of an ounce and is made from a combination of large and small cotton mesh instead of the closely woven material generally used. It is carefully patterned and cut so that it will fit over the head and hair easily and will always keep its shape.

This cap may also be laundered, and it is furnished in white for candy and food-products factories, bakeries, and the like, where it lends a decided air of cleanliness and efficiency; or it may be had in brown, a serviceable shade for machine-shops.

The Paint-Sprayer that Can't Spatter

PAINT-GUNS and paint-sprayers are constantly being invented, and yet we continue to see the hand painter on the job, complacently drawing his large wages each fair day.

Why is it that the sprayers and guns do not flourish more rapidly? One reason is loss of paint; another is the spattering on surfaces not to be painted; and, besides, the paint is apt to get a chalky consistency due to the evaporation of oils while still in the air.

There is, however, a new paint-gun designed to overcome these objections. The nozzle has two openings—a central one for paint and an annular one around it for compressed air, whose pressure is sixty pounds per square inch. This surrounding air carries the paint to the surface and is so powerful that the paint can't break through it. Thus it is neither lost nor spattered. The paint is released in bulk. Hence the oils in it do not dry before they should.

The wall of air that completely surrounds the paint guards it against wind and dirt, while it also guards the surrounding territory that does not need paint.

Even in the heaviest wind this paint-sprayer can be operated successfully. And when there are dirty surfaces to be cleaned, the painter can use the compressed-air jet for the purpose.

There are two openings in the nozzle of this paint-sprayer—a central one for paint and an annular one for compressed air

December, 1920

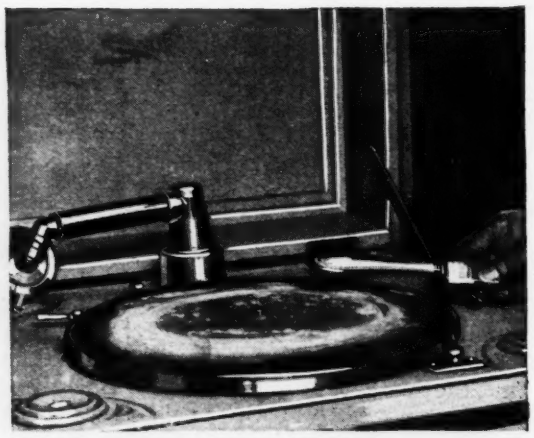
New Jobs for the Phonograph

It whirls other things just as easily as records

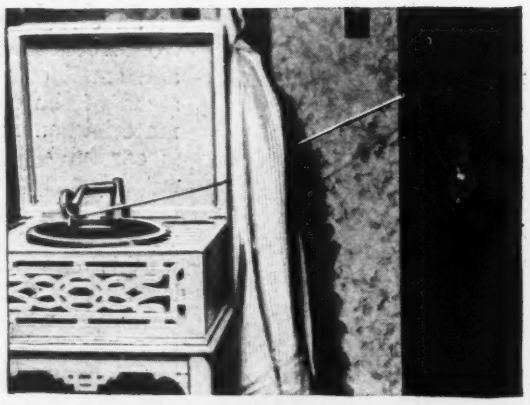
This man made some wooden candlesticks; when they were stained and ready to be polished, he placed them on the phonograph turntable and held the polishing-brush firmly in his hand

Why pay to have your nails polished when you can shine them yourself without expending any energy? Simply attach a circular buffer to the turntable and pull the starting lever

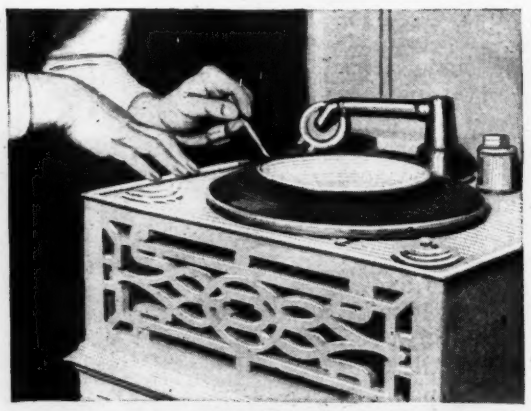
Place a glass containing a drink on a stand fitting over the center pin. Attach a stationary arm with an adjustable lever to the phonograph. The lever will stir up the drink as the glass revolves



The cleaning of silverware is always a bugbear to the housewife. By smearing the turntable with polish the phonograph can be used to shine all the knives and forks



"Help! Help!" shouts the record when a burglar opens the door. A string is tied to the door-knob and the release lever of the machine. When the door opens, the record yells for help



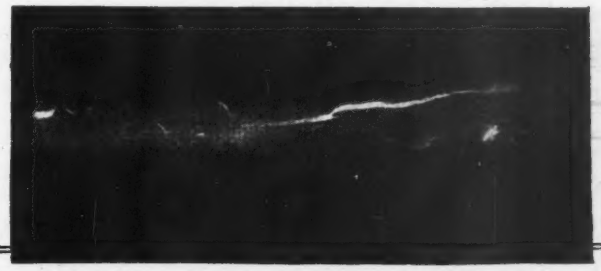
You can buy plain white dishes and some gold paint. Place each dish on the turntable of your machine and hold the wet brush against the edge when you turn on the power

To See What's Inside

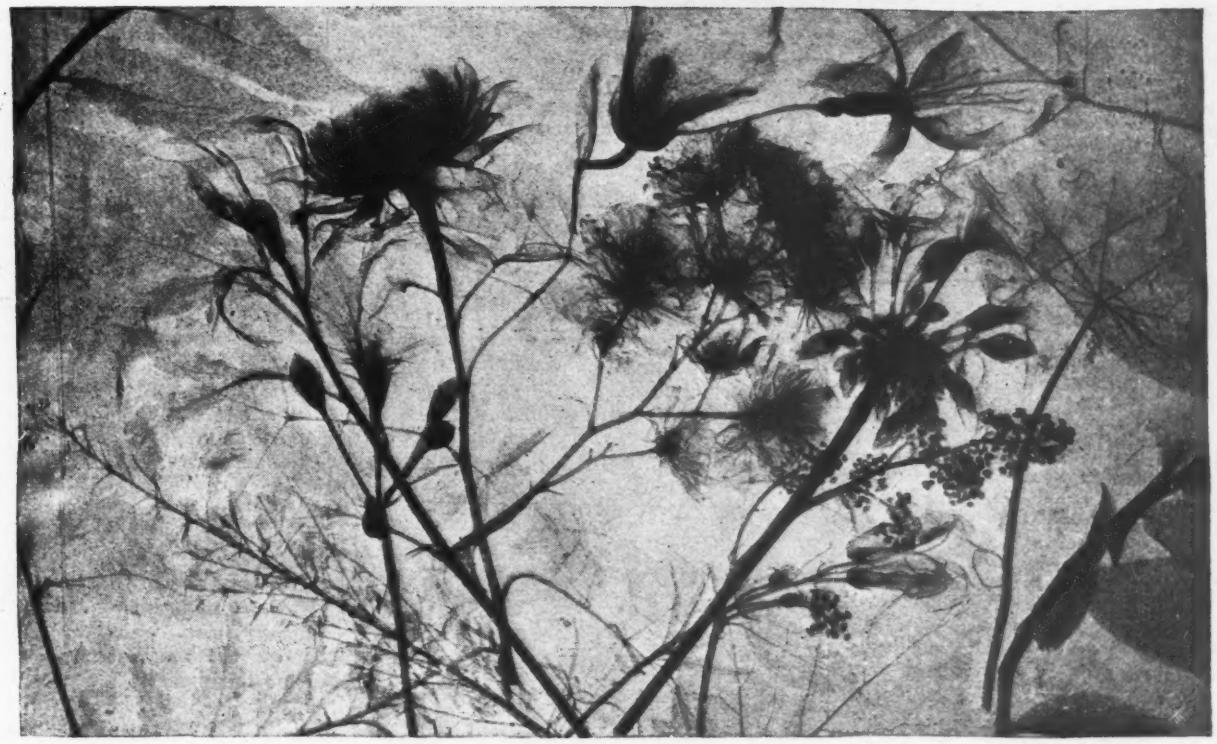
Have an X-ray photograph taken

A four-legged chicken becomes scientifically interesting when examined by the X-rays. This chicken was five hours old when the X-ray picture was made by Cox-Cavendish

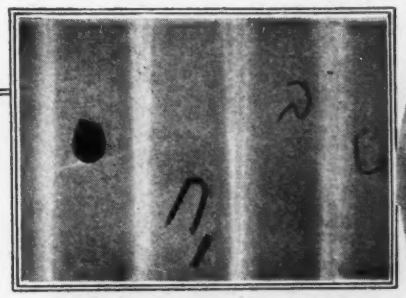
X-rays can now be made in a second or two, instead of waiting twenty minutes for their light to affect the photographic plate. Below is an automobile tire with the X-rays shining through it, contributed by the Cox-Cavendish Electrical Company to the Röntgen Society's recent exhibit in London. The canvas fabric can be seen through the rubber tread



You can have an X-ray picture made of your watch to see what is wrong with it, as this one by Cox-Cavendish shows. X-rays penetrate every substance except lead

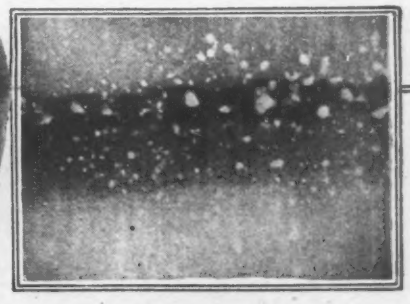


Of special interest to botanists were these radiographs of roses, fuchsias, fern leaves, and other leaves, made by Dr. Robert Knox, of London. The application of the rays to plants facilitates the diagnosis and study of plant diseases



A radiograph (by the Cox-Cavendish Electrical Company, of London) of a cake of chocolate showing pieces of wire and a staple in it. We hope these were mixed in the cake for X-ray purposes and not by accident

Here is Dr. W. F. D. Chambers' X-ray photograph of an ammonite. Although a fossilized ammonite apparently consists of a homogeneous mass, the rays discriminate between the shell and the filling material



Radiographs of metals are important. This picture, made by Cox-Cavendish, is of a weld in a steel bar, showing imperfections in welding. The white marks are air spaces. The rays can penetrate half an inch of steel

The Card Tells the Price

IN order to keep the customers' memory informed of the rising cost of milk some dealers are now using a clever device.

The information is printed on a strip of cardboard in which a hole is cut at one end. When a bottle of milk is left at a house, one of the cards is slipped over the neck of the bottle. The customers have no excuse for claiming that they did not see the notice, for they must remove it from the bottle when they take it into the house.

When an Airplane Collides with a House

WHILE trying to get into the air after a stop at Omaha, Nebraska, the tall weeds in the field through which a metal airplane was "taxi-ing" acted as a brake. When the machine otherwise would have been high enough in the air to clear all near-by obstructions, a series of telephone wires and a house loomed just ahead. The result is shown in the photograph reproduced below.

One wing of the monoplane was damaged and its running gear was torn off. Captain "Eddie" Rickenbacker, who was one of the passengers, was the only one hurt. He described his injury as a "severe fracture of the straw hat."

A Headlight for the Walking-Stick

ANY man who walks along a dark country road at night needs both a stick and a flash-lamp. The man who rides in taxicabs or on the top of buses needs a light when he looks for change to pay his fare. Here is a walking-stick that combines its natural advantages with those of a light.

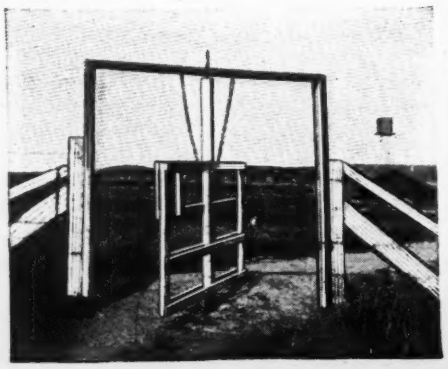
A small flash-lamp is fixed in the handle of the stick. The handle is hollowed out to accommodate the battery, while the lens and the small electric bulb are fixed in the tip of the handle.

This same principle might be applied also to umbrellas, as a convenience on dark, wet nights.

A Self-Closing Two-Way Gate

HERE is a gate that swings on a central post which has a short iron rod inserted at top and bottom, the top rod passing through the lintel of the gateway, the bottom rod working freely in a block set in the ground. The gate is hung by two chains to the lintel, the fastenings being on each side of the center post of the gate. The center post rises as the gate opens.

The principle of gravity could scarcely be more satisfactorily applied to a simple contrivance for every-day use than it is in this contrivance.



He Makes His Rounds on Skates

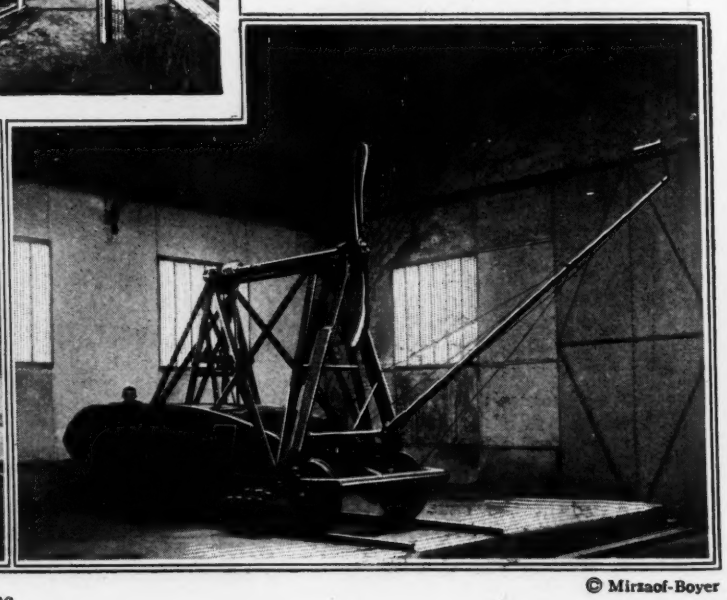
MAKING the round of inspecting fire hydrants, the policeman who has to cover a long beat may find himself slipping on his job when the streets are covered with ice. A policeman in Columbus, Ohio, got around the difficulty by directing his slipping to a purpose. With skates on his feet, he found that he could make better time covering his rounds than when he walked on a dry pavement.

If, by chance, he should meet a thief, he would have the advantage in a chase over icy pavements.

How the Thrust of a Propeller Is Measured

THE air-screw or propeller of the airplane, while far from being in an experimental stage, is still subject to scrutiny by inventors. Not only are improved methods of manufacture being studied, but the shape and power of the propellers are also being examined and tested, in the hope of reaching greater efficiency.

One method of testing is that shown below. The propeller is attached to a car which runs on rails that offer the least resistance. But the car is attached to an overhead device which enables the "pull" of the propeller to be accurately measured. This makes it possible to compare propellers of different types.



© Mirzaof-Boyer

A Penholder Support for the Beginner

HERE you see a penholder support that teaches you the proper way to hold a pen.

It is made of spring wire and has a loop at each end. One loop fits over the little finger which rests on the table, and the other fits over the holder. The length of the wire between them is sufficient to keep your fingers from becoming cramped.

You are forced to hold the pen loosely and thus you write smoothly. The loop that is placed about the penholder can be adjusted to any position you desire, thus changing the angle of the holder.

Is there anything in that idea of one's penmanship indicating character?

Down Comes the Steeple to Thrill "Movie Audiences"

LIGHTNING has always been a great enemy of church steeples. A glance at this picture would tend to make one believe that the airplane will also do its share in destroying steeples.

Not so, however, since this picture is of another "movie" thriller. The church steeple is constructed of very light material, so that there can be no danger of damaging the airplane. In case of a real argument between a real church steeple and a real airplane, the airplane would be sure to lose.

This stunt was not accomplished without any danger, however. Few movie stunts are. When the airplane struck this steeple it was traveling at high speed—probably from sixty to seventy miles an hour. At this tremendous speed the aviator was taking a great risk by allowing his machine to strike anything, no matter how frail or delicate. When a machine is traveling at this high speed, it does not require much to upset its balance and dash it to earth with its occupants.

Neatly Bringing a Soft Collar Together

MORE and more do men wear soft collars the year round. The soft ones are comfortable, easy to put on—but they do not look as well as the stiff ones. Some people object to buttons and buttonholes that hold down the ends. There is now a slip-on fastener that clasps both ends firmly and holds them down close to the neckband.

The fastener consists of a slightly curved bar with a double loop at each end. The space between the sides of the outgoing loop is so small that the collar edge can barely be slipped through it. Once inside, the edge is held firm.

These fasteners have been made in various metals and designs to suit every taste.

Irrigation by Horsepower in the Holy Land

DAMASCUS, one of the oldest cities in the world, is far behind the smallest American desert town in the matter of irrigation. Instead of using a pump for raising the water from the river, a team of horses aided by a windlass does the work.

A leather bag is lowered into the river, where it takes on a load of water. Then the horses are driven forward. As a result, the ropes that are attached to their harness and passed across the windlass draw the bag up to a level with a trough that leads to a ditch. The bag is tipped, the water runs into the trough and into the irrigation-ditch.

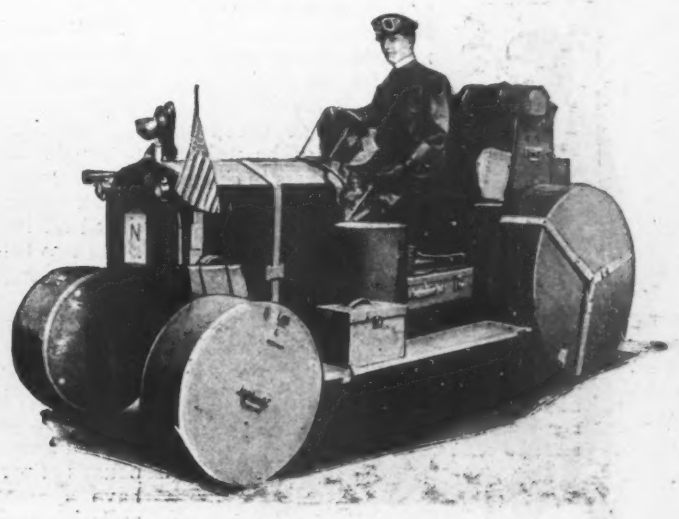
An Automobile Made of Luggage

STAND a hatbox on its side and it looks not unlike one of the disk wheels with which some cars are adorned. Then there is the trunk with the curved top; does it not resemble the hood of an automobile?

The proprietor of a Berlin leather goods store noticed these similarities, and decided to build an automobile out of his wares. Hatboxes, suitcases, "grips," and satchels were used chiefly. One small satchel made an excellent tool-box and was placed on the running-board.

When this luggage-made automobile was finished, it was placed in the window of the store and attracted crowds.

© Underwood & Underwood



A Motor Snow-Plow for Sidewalks

EVERY one is familiar with the small gasoline-engine lawn-mower as it speedily travels around the large lawns of city parks in summer. We may wonder why such a device has not before been adapted as a snow-plow to clear the sidewalks after a winter storm.

The man who has to swing a shovel in the hard work of getting the snow cleared away from a long stretch of pavement will certainly appreciate this invention. Employed by a traction company, it serves well to clean off the street corners where the cars stop, making a wide path for the passengers who are waiting for cars.

Easily portable and easily controlled, this hand snow-plow can combat the heavy masses of a formidable snowbank, and in cleaning sidewalks is very efficient.

One of Our Bird Veterans of the War

CARRIER pigeons won distinction by heroic service in the great war. Some of the bird members of the pigeon section of the Signal Corps were killed or wounded. In charge of the twelve thousand pigeons were twenty officers and 542 enlisted men.

The mile-a-minute speed of the birds enabled them to convey messages from inaccessible places.

At St. Mihiel, 567 American homers were used. Twenty-four out of 202 were killed when released from tanks in action.

One of the homers used in tank work, "President Wilson," with his leg shot off, flew through fog and rain, and heroically won official commendation. This hero was one of the veterans exhibited in St. Louis at the convention of Rexall druggists in September.

A Headlong Flying Leap on Skates

LAKE PLACID, in the Adirondacks, holds a peculiar charm for the winter sportsman. The hills afford an opportunity for skiing and skijoring, while the smooth surface of the frozen lake invites such games as curling and hockey. But skating meets the all-round popular demand, and to Lake Placid in midwinter come the world's champion ice-skaters.

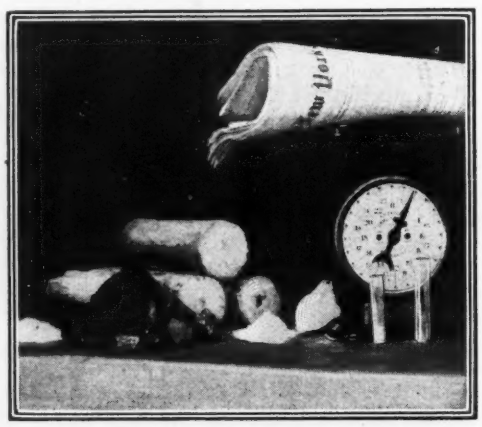
Stunts such as jumping, dancing, and ice-acrobatics are much enjoyed by the crowds of visitors.

The photograph above shows Earl Palmer, of Plattsburg, New York, in the act of making a daring jump over three barrels. This took place during the contests for the international championships. From the attitude of the skater's body the "landing" looks precarious.

Rover Makes a Clever Caddie

AN Airedale will make a very capable caddie if he is trained to carry the golf-sticks and to "stick" around. Golf is such a leisurely played game at times that one's caddie may stray away and not be at hand when most needed. A dog is more likely to stay close to his master, and as the burden of sticks is not a heavy one, the animal will not be inhumanely treated if he is required to make himself useful instead of merely lazily present.

This particular dog caddie actually has become an enthusiast of the game. At every shot his attention is on the alert, and he watches the play with the keen eye of a connoisseur. Not only that. His mistress never loses a ball, for the dog's eyes follow it attentively, and running to the spot where it lies, he waits for his mistress to come up and take another shot.



The Wood Used to Make a Sunday Paper

THE principal cause of the present paper shortage is the fact that no satisfactory substitute has ever been found for spruce wood.

It is said that one great New York newspaper devastates ninety acres of spruce timber every day.

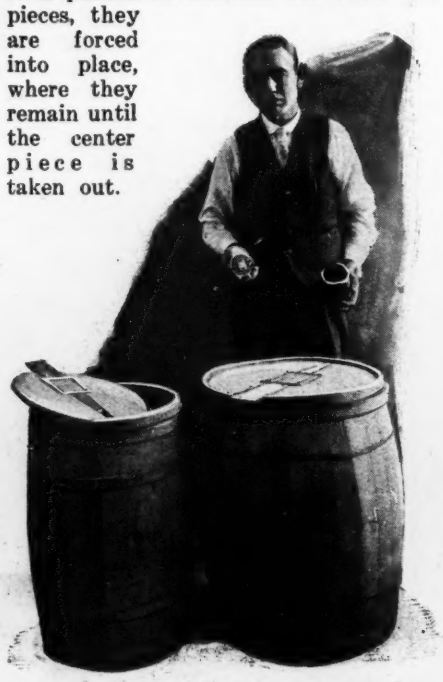
Ten years ago the United States produced all its paper pulp. Today it imports two thirds of it, and our spruce forests are dangerously near extinction.

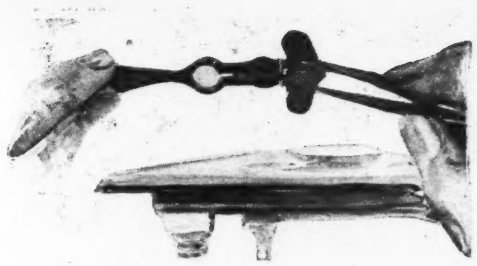
The big Sunday newspaper above weighs nearly two pounds, and the approximate amounts of the materials in it are shown beneath it. They are one ounce of bleaching powder, two pounds of coal, one ounce of sulphur, one and one half ounces of unslacked lime, red and blue dyes, and three pounds of spruce wood. If the paper is to have a smooth finish, rosin and other materials are added as "sizing."

Good Tops Make Good Barrels

DID you ever try to get a barrel-top off without making kindling-wood of the barrel? It is a trick that most people cannot do with an ordinary barrel. With the barrel shown below it is different. It is not necessary to use a sledge-hammer on a barrel with a wedge top.

The top is made in three pieces. The middle piece is wedge-shaped, and when it is pushed in between the other two pieces, they are forced into place, where they remain until the center piece is taken out.





Setting Small Jewels in a Watch

WHEN it is necessary to use a magnifying-glass to see distinctly the tiny jewels that every good watch contains, one is naturally curious to know how such minute objects are set properly in their places.

These tiny jewels must be ground in precise geometrical forms and exactly set, to be useful.

A jewel-setting tool, the invention of Carl Culman, of Maplewood, Missouri, is a device to help the watchmaker. It is so constructed that one jewel may be set in without interfering with another that is already in place.

In appearance the jewel-setter resembles a cross between a surgical instrument and a pair of pliers, but it is like neither. It can be used in various operations in repairing a watch or a clock, where very small objects and delicate work must be handled.

Messrs. Winter and Water, Nature Sculptors

DURING the cold weather a water-main broke and sent up a spout of water about eighty feet in the air. Of course, the water had to come down. It fell and quickly froze in beautiful festoons along the limbs and branches of the trees in the neighborhood, making grotesque shapes of silvery whiteness.

In the morning sunlight, the ice glittered and sparkled, and the sight of a group of ice-trees in the heart of a city attracted crowds of visitors.

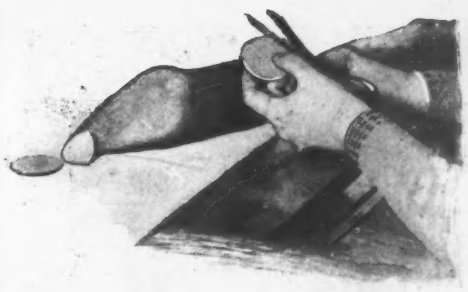
It was the extraordinarily intense cold that caused the water in the main to freeze and the expansion of the water caused the pipe to burst. But the pressure of the water in the main was too strong for the resistance offered by the ice-plug—so the spouting water shot high above the pavement.

A Clock that Literally Tells the Time

HAVING studied the matter for sixteen months, Vincent Pinto and his son Joseph, of Philadelphia, invented a clock that talks. The old saying that "time will tell" is now a reality. The clock speaks the time instead of striking the time at certain intervals.

It can be made to speak at any time during the day; but for convenience the model clock has been regulated to speak every quarter of an hour. A few seconds before the minute-hand reaches the quarter hour, the mechanism is set in operation and announces the time with an appropriate or humorous remark. For instance, in the morning it serves as a reminder to get up. At seven o'clock, besides announcing the time, it can be made to say that breakfast is ready. At four thirty in the afternoon it will remind mother to prepare dinner. At eight in the evening the children may be reminded that they should be in bed.

The entire mechanism of this useful attachment may be condensed to fit into an ordinary table or mantel clock.



Rubber Tire Patches Make Good Rubber Heels

MAKE your own rubber heels and toes from tire patches. All you have to do is cut down the patches to fit, and glue them firmly to your shoe, and they are all ready for service.

You will probably never want to use the patches on your inner tubes, anyway—it is so much easier to pay a quarter or a half dollar to have a tube patched at a garage than to do the job yourself.

Toe patches have become quite necessary since women have taken to long-pointed shoes. After a few weeks of use the points become dull and worn to a wafer at the extreme point, and either new shoes or patches become necessary.

These tire patches are likely to be useful in various other ways around the house. That leaky hot-water bag can be made whole; likewise the hose of the bath-spray or the garden sprinkler.

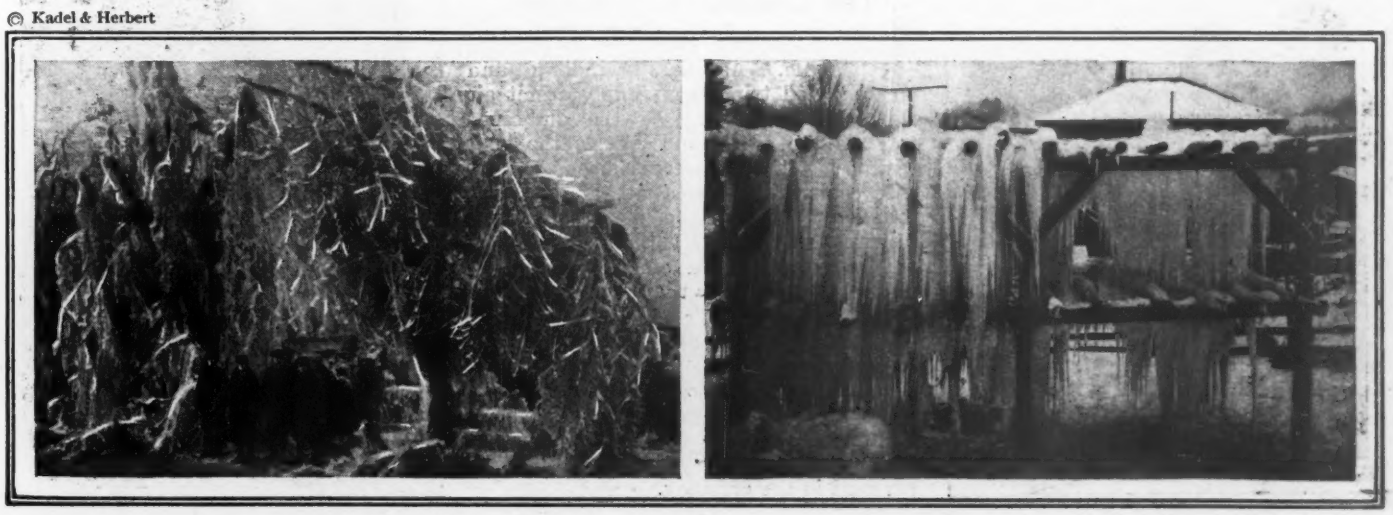
Now Is the Time to Make Your Own Ice

A TRESTLE carrying a device similar to a lawn-sprinkler, so that the water is sprayed across its top, makes a satisfactory midwinter ice-machine. The water will freeze in successive layers as it trickles over.

When ice may be properly stored, there is no better way to take advantage of winter to obtain a fresh, clean supply of it. The swinging or rotating motion of the sprinkling device will distribute the flow of water so that it will not form the ice all in one spot. The ice shapes that are created from such tiny particles of water may thus be made serviceable when stored away for next summer.

When a fine, misty rain freezes upon the branches and bushes, the garden and the woods both become places of beauty. Now it is possible to create artificially the same effects.

© Kadel & Herbert



A Steel Punch and Bender

THE man who would punch holes in a steel bar, or who would bend strips of metal, needs a machine that has great strength of construction, and that can be easily manipulated. Here is a steel punch and bender that can be changed from one to the other without loss of time. Hand levers apply the pressure to the bars holding the various tools.

If the machine is to be used as a punch, just slip the punch and die holder with the bolt in the slot, and from all sides the punch is visible to the workman. More than one punch and die may be clamped in the machine at one time.

A Sled that Is Propelled by Hand

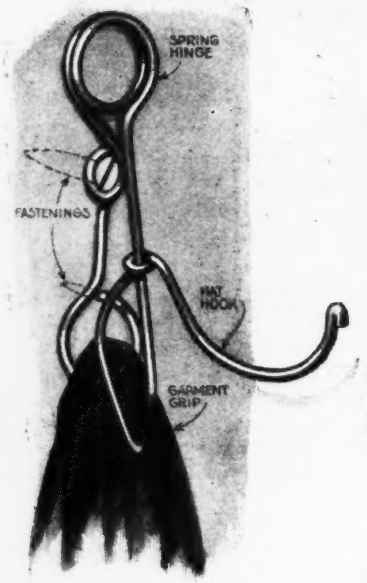
IN some parts of Europe farmers use spikes to provide a means of motive power for crude sleds. The spikes are dug into the ice and thus a man can propel himself over the smooth surface of the ice.

The device is a simple application of that now employed by arctic explorers in motor-driven sleds. There the smooth runners enable the vehicle to slide with least resistance, while iron-spiked wheels, or "caterpillars," propel it along by engaging the ice in a firm grip.

Safety First for the Man Who Oils the Machinery

DID you ever hear about the man who tried to oil machinery while it was running, and who stood upon the top of a stepladder to do it? Well, the ambulance got him first, and then the undertaker came for him. The ladder slipped on the oily floor and the machinery did the rest of a disastrous job.

To prevent such accidents there is an oil-can having a long extension which enables a man to stand upon the floor and reach every part of the machinery that requires oiling. A long spout connected with the can, arranged to send the oil up to the top of the spout, is the handy equipment that should be installed in every factory.



A Spring Hanger for Clothes

A NEW metal clothes-hanger upon which one can quickly dispose of the garments in a closet has been invented by John L. Lyman, of Easthampton, Massachusetts. This hanger differs from the ordinary clothes-hook in that it embodies a device by which the article placed upon it is held in a spring grip. It takes up the minimum of space and permits a number of garments to be hung upon it.

The device consists of a single piece of wire having a suitable amount of resiliency to grip the garment by spring tension. It can be placed in the panel of a door or attached to a shelf.

Bobsledding When There's No Snow

IN Switzerland many people have put wheels on their sleds and enjoy all the thrills of coasting down hills even though no snow has fallen. In fact, many sleds are made originally with wheels instead of runners.

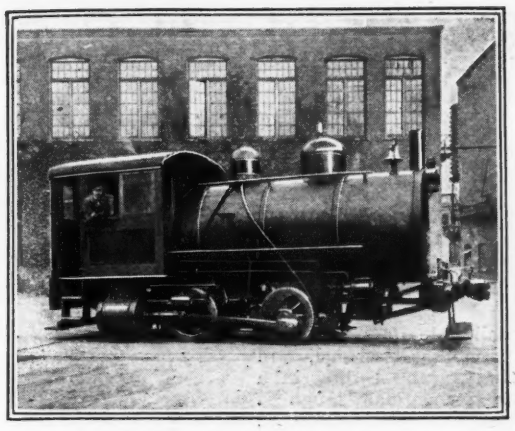
The chief objection to snowless coasting is the danger of spilling. You land on hard, dry, resisting dirt, and are very apt to bruise yourself or at least ruin your clothes. Snow, on the contrary, is usually harmless, unless it is frozen hard.

The Coal-Stove Unadorned

A COAL-STOVE should be as plain as possible. Isinglass windows and nickel-plated trimmings simply admit air through the joints. As the air seeps through the joints and cracks, the heat within the stove is decreased.

A coal-stove, chosen at random, was tested by one of the members of the American Society of Heating and Ventilating Engineers for the amount of carbon-dioxide directly over the flame and in the chimney. Nine per cent of it was found over the flame and only four per cent in the chimney.

In preparation for a subsequent test, all the air leaks were then sealed up with cement. The second test revealed eleven per cent over the fire and eight per cent in the chimney.



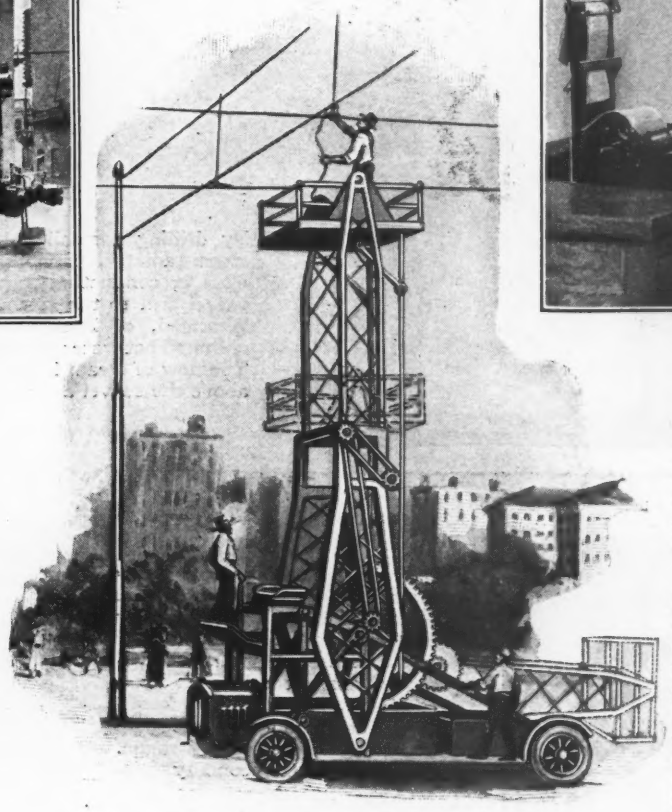
No Fire on This Locomotive

"AN odd-looking locomotive," you will say. It is a locomotive without a fire. How does it run? By steam, of course.

The steam is not generated on the locomotive, but in a separate boiler located in the yard. The boiler of the little locomotive is used only in storing steam.

Steam is pumped into the locomotive under considerable pressure. This finds its way into the cylinders through a valve which reduces the steam pressure to about one third the pressure in the boiler.

This method of locomotion prevents the buildings about the yard from getting dirty and also eliminates the fire risk, which is most important.



A New Tower for the Man Who Repairs Overhead Wires

HERE is a new way to get into the air to repair overhead wires for trolley-cars. This tower is comparatively light in weight, but it is so constructed that several men may work on the platform without danger of it collapsing. It is trussed in the manner of a bridge. When the tower is not in use, and during transportation, the upper half is telescoped into the lower half and the whole thing is allowed to drop slowly until it comes to rest on the bottom of the truck carrying it. In this way it can be carried from place to place without trouble.

The whole structure can be brought to position by one man. It is necessary only to control the motor, which motion is transmitted to the tower through a train of gears. When the tower is brought to an upright position, the upper half is raised by power to the height desired.

A World's Champion

LOOK above and you will see the world's fastest typist. She has copied one hundred and fifty-one words in one minute. This is a speed of more than two and one half words a second.

Attention must be given to details to attain such a record. For instance, the typewriter should be fastened securely to the desk without the drop-bed feature. The drop-bed tends to increase vibration, and this interferes with high speed. The typist should have a fixed back chair with her knees braced against the desk to keep her the proper distance from the machine.

Hercules in the Locomotive Shop

WHEN locomotives are repaired, it is no longer a case of getting out and getting under. That is too much trouble. The modern method is to raise the locomotive.

Hydraulic pressure is used in lifting the locomotive from the floor of the shop. A large locomotive can be placed on the lift and hoisted up a distance of five or six feet in a few minutes' time. This hydraulic hoist is capable of lifting a weight of two hundred tons with ease.

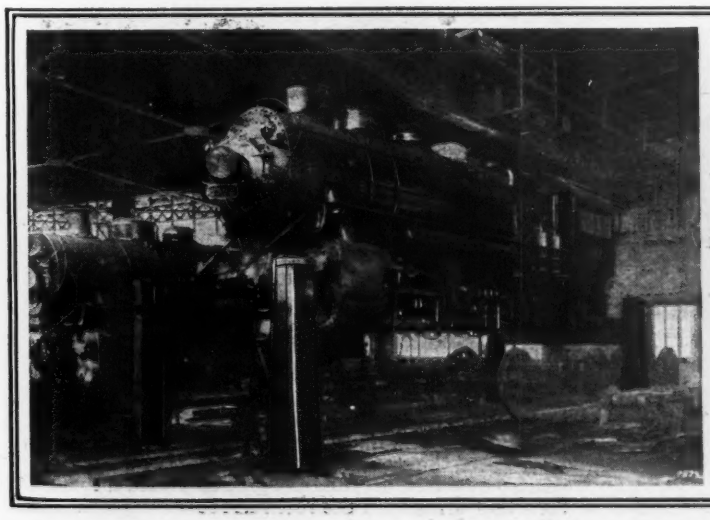
Hoists of the same design, but having six posts instead of four as shown, are made to lift a weight of three hundred tons without groaning. The six-post hoists are used with long locomotives, so that no strain will be imposed upon them.

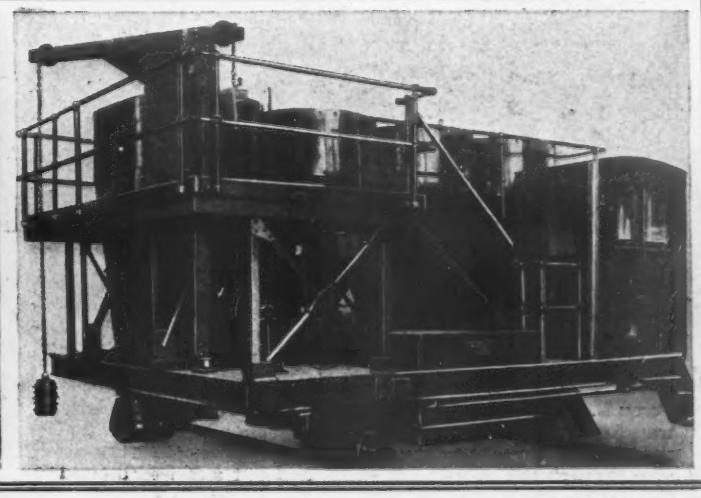
This Is a Busy Little Car

THE car pictured below is used in a great chemical plant. It is kept busy measuring out large quantities of the different ingredients that enter into the process. It is driven electrically and runs about the yard measuring out so much of this and so much of that.

The large kettles carried on the upper deck of the car are the measuring units. They are filled up and lifted off with the electric derrick mounted on the top. While this may appear to be a crude method of measurement to those who are accustomed to smaller units, it is accurate enough for use in the production of large batches of various chemical products.

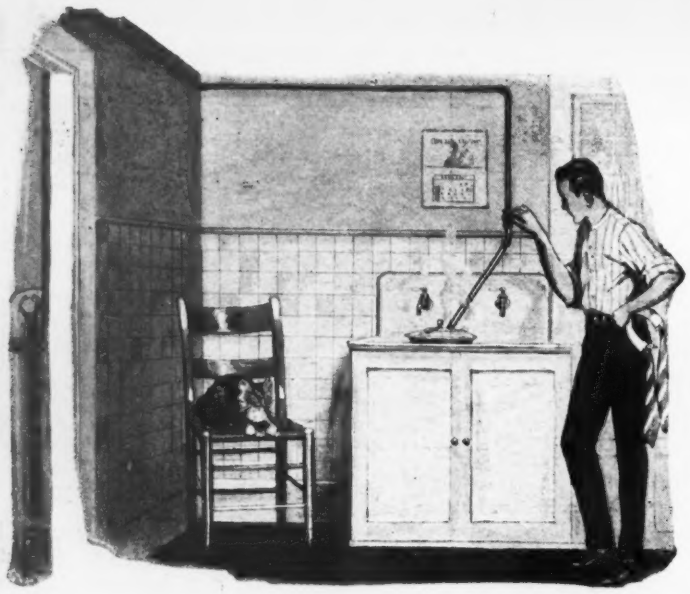
This car is used in a by-products coke plant.



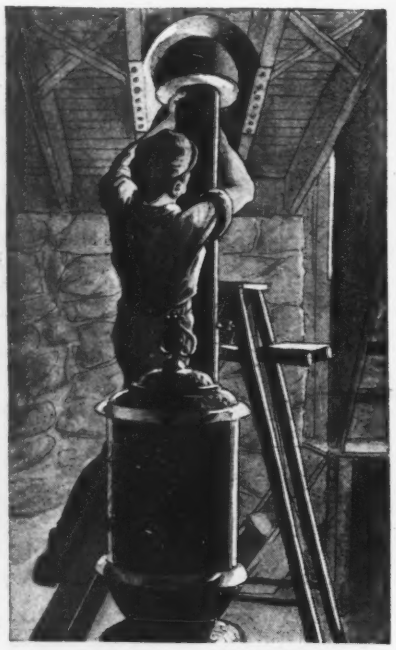


Fighting the H. C. L.

By exercising a little a few hours to home other ways of reducing

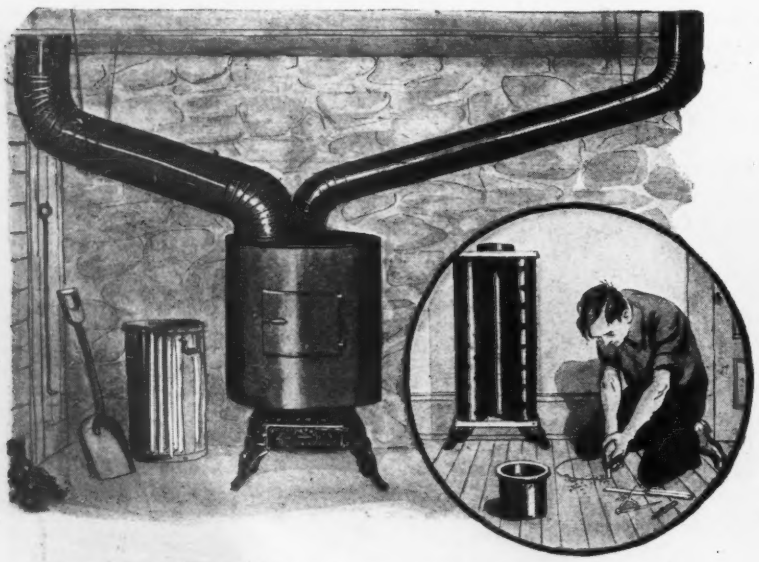


By drilling a small hole in the nearest steam-radiator, threading the hole, and from it conducting a pipe ending in a swivel arm to the kitchen sink, Hugh E. Westfield, of Rockland, Massachusetts, obtained hot water all winter at small cost. The flow of steam is regulated by a valve above the swivel arm

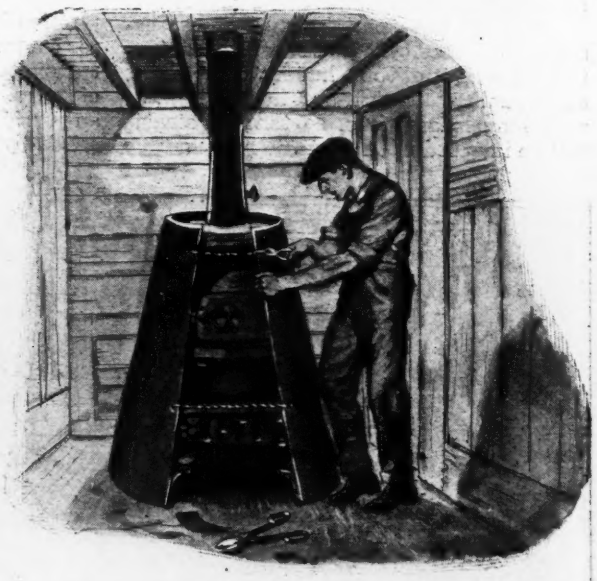


Left. With a coal- or wood-burning stove in the cellar, Charles E. Upton, of La Fargeville, New York, defies the coldest winter blasts. He conducted the stove-pipe through the kitchen floor, carefully protecting the woodwork, and connected the pipe with that of the kitchen range. It meant greater economy

Right. Three or four sheets of newspaper, folded once and then rolled tightly and twisted together, make a good substitute for wood in kindling a fire in the stove or grate. William J. Albin, of Oakland, California, who suggests this method of saving fuel, finds that paper rolls burn slowly and give much heat



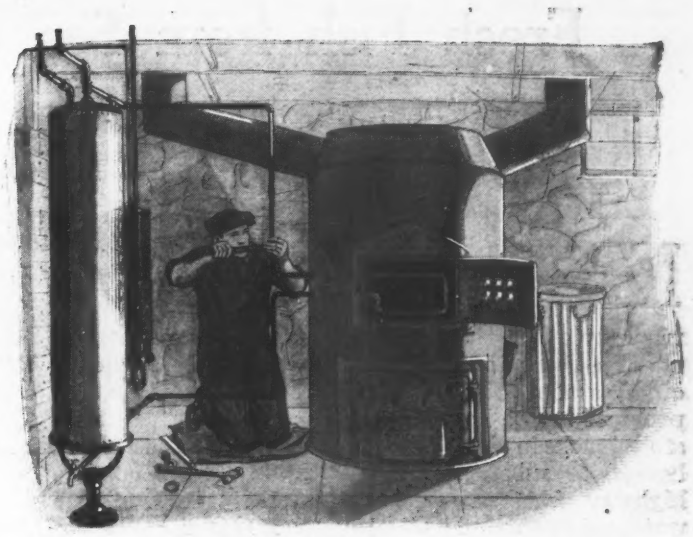
Percy L. Anderson, of Wilmington, Delaware, saved fuel by transforming a small coal-stove in his cellar into a hot-air furnace. He put a tin box around the stove, conducted a hot-air pipe through the floor of one room, and put a register around the smoke-pipe in another room



From an old railway-car stove H. M. Beach, of Fort Plain, New York, improvised a hot-air furnace. He surrounded the stove with a tin jacket in a walled-in space 6 by 6 feet. Around the pipe he placed a drum communicating with the room above

at the Cellar Furnace

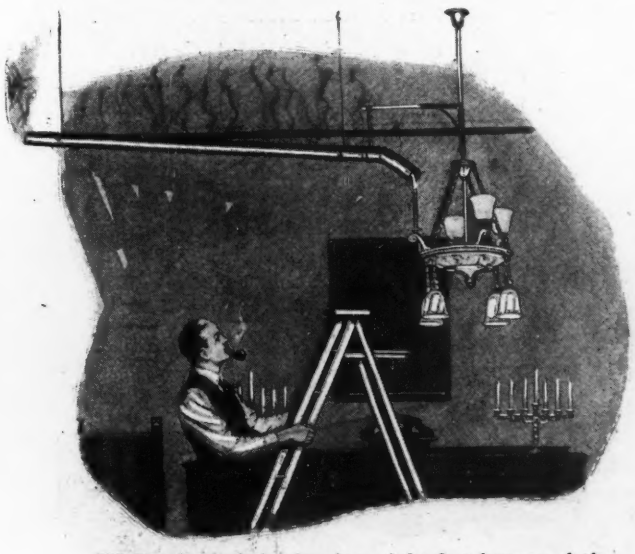
ingenuity, and devoting tinkering, you may plan your living expenses



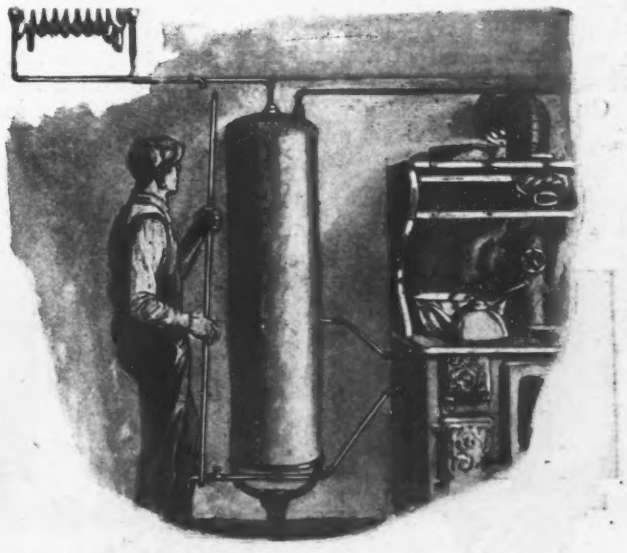
When the hot-air furnace in his cellar is in use, Jacob A. Ruof, of Philadelphia, saves much coal by heating the water for kitchen use in pipes which form a loop in the fire-box of the furnace. At such times the gas-heater connected with the water-tank is not required at all

Left. By utilizing the waste heat in the chimney, William H. Morin, of Oxford, Massachusetts, achieved a considerable saving of coal that would have been required for heating the water for kitchen use. He placed the water-pipe in the chimney, connected the upper end with the kitchen faucet, and the lower end with the supply-pipe

Right. For the purpose of saving fuel, C. L. Meller, of Fargo, North Dakota, set up a sheet-iron drum in his living-room and conducted the hot gases in the chimney through the drum by connecting it below the floor and near the ceiling of the room with the flue



With a discarded rain-pipe, eight feet long, and the flame of a gas-burner in the living-room, William L. Wray, of New York, kept his family warm when a cold day found him without coal. By filing a hole in the lower part of the burner he made it a Bunsen burner



By connecting the hot-water tank in the kitchen with a radiator in the room above by means of pipes, Arthur Johnson, of Ironwood, Michigan, heated that room comfortably without extra expense throughout the cold season, when the kitchen range was in constant use

Fresh Fish from Sea to Door by Motor-Truck

To make the motor-truck serve your business efficiently make a study of the handling and transportation problem

By Joseph Brinker

MOTOR-TRUCK transportation is so new, as compared to the other forms of rail and water transportation, that the prudent business man will do well to make a thorough study of his transportation problem before he installs trucks in place of horses, or substitutes highway for rail or water shipments. The need for this study is due to the fact that the motor-truck cannot be run on horse-pace methods and achieve its greatest degree of economy.

A Truck Must Give Double Service

On the average, truck equipment will cost approximately double the horse-wagon outfit to carry the same load. Therefore, at the outset, irrespective of the higher operating costs, the truck must do twice as much work as the horse in order to perform the work at the same cost per ton, load, or package, as the case may be. Owing to its inherent speed, the truck, in ninety-nine cases out of a hundred, can do twice the work of the horse equipment—provided it is kept moving and used as a vehicle instead of a warehouse on wheels.

Only an advance study of the transportation problem will enable the business man to decide whether trucks can be made to save him money in his haulage or delivery. If the first analysis of the problem shows that the trucks will be standing still for the greater part of the working day, some means must be provided for reducing the idle standing time. Sometimes it may be self-dumping bodies for unloading, and overhead hoppers with chutes for loading bulk material, that will speed up the truck, cut the idle time to a minimum, and make it not twice but three or four times as efficient as the horse-wagon.

Again, it may be that demountable bodies will solve the problem—bodies that can be rolled off the truck chassis or lifted off by a crane or derrick.

Although it is not often considered, the method of handling the goods just before they are loaded on the trucks or unloaded from them has a great deal to do with the efficiency of truck operation.

Study the Loading Problem First

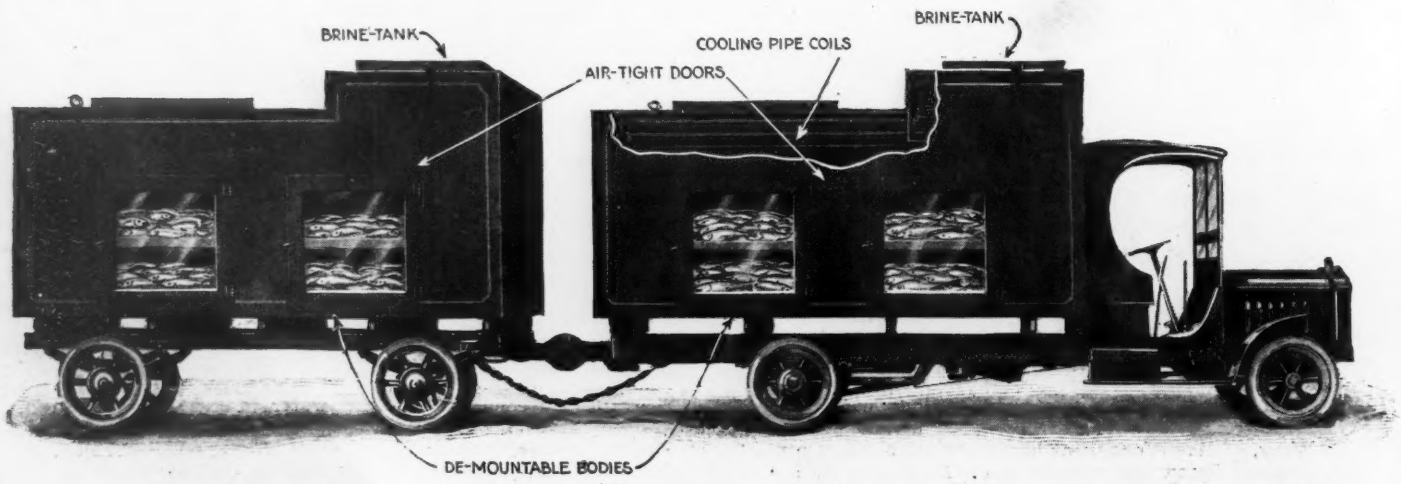
For example, if the goods have to be moved on hand trucks over a long distance from the point where the load is made up to the tail-board of the truck, there is liable to be considerable delay in loading. Meanwhile the truck is standing idle, thereby reducing the amount of work that it can do in any given time.

Similar delays are caused when the loaders have to lift the goods in placing them in the truck body. Delays of this nature may be avoided by the use of small industrial electric trucks to move goods from the points of pick-up to the tail-boards of the trucks. These

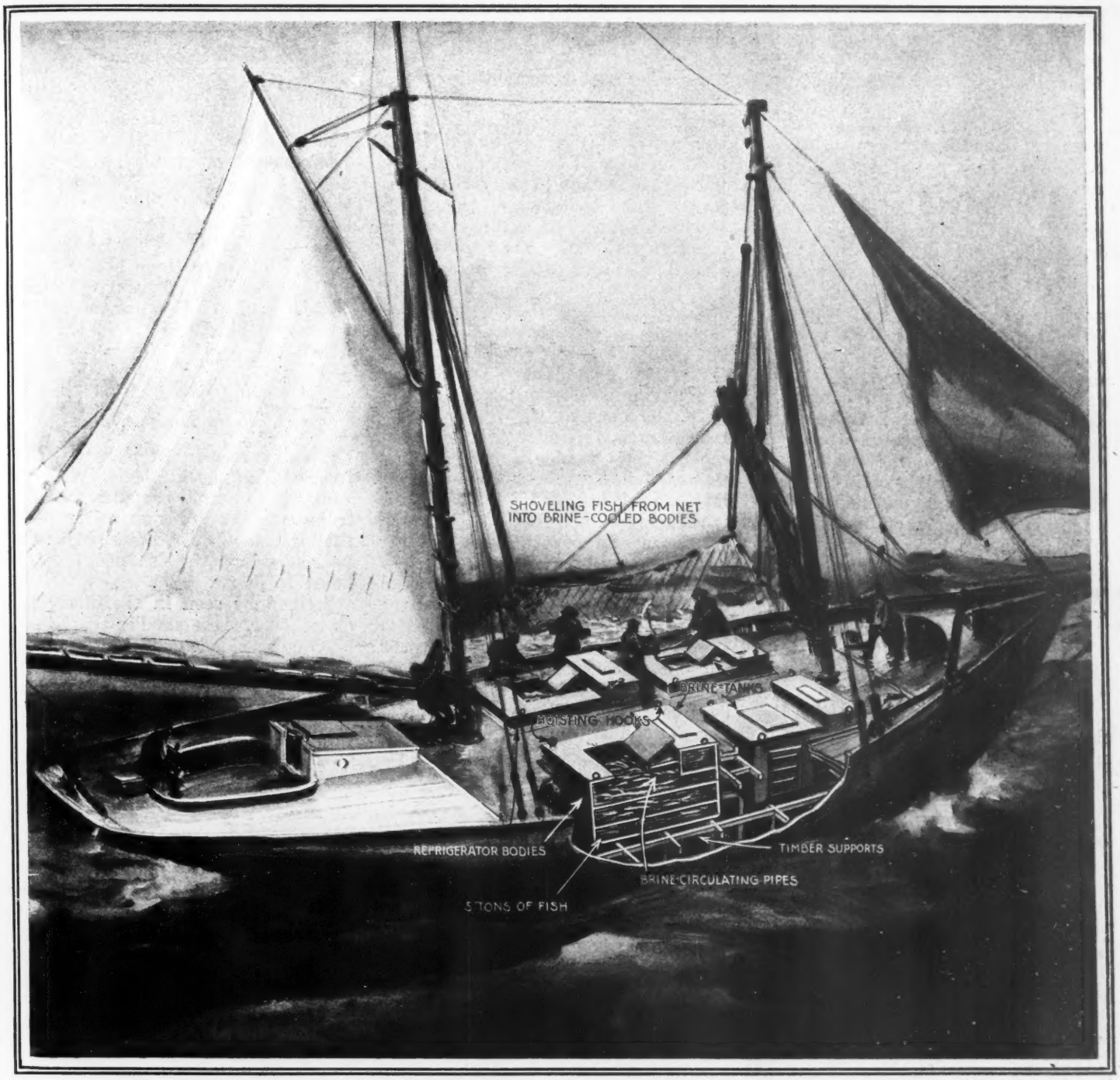
The Difference between Horse-Wagons and Motor-Trucks

Too often business men attempt to install motor-trucks in their businesses on horse-pace methods. The trucks simply come in when the horses go out. Because motor transportation and horse haulage are inherently different, the greatest economy of trucks cannot be secured if the merchant simply introduces the new form of delivery for the old without other changes that will speed up the handling and loading of the goods to the same degree as the truck speeds up the actual delivery.

In this article, the sixth of the Popular Science Monthly series on truck transportation for the business man, Mr. Brinker shows what exceptional economy may be secured by the use of trucks if sufficient study is given to the particular haulage problem under consideration. Rapid loading and unloading means demountable bodies; to secure the utmost efficiency the use of trailers may even be necessary.



The latest plan to deliver fish to the kitchen involves the use of 1½-ton trucks. Loaded from the local warehouse, the fish are peddled from house to house. The trucks have glass doors, so that the fish inside may be seen



The hatchways of the fishing-smack between the foremast and the mainmast are so arranged that four truck bodies can be carried in the boat to the fishing-banks. Doors at the tops of the bodies are opened, and the fish are pitchforked directly into the truck bodies

small electrics carry much more than a man can push on a hand-truck, are speedier, and are not subject to human fatigue.

Various Ways to Speed Up Loading

If such vehicles are not suitable, spiral gravity chutes may be employed to get the goods quickly from the upper floors to the shipping-room from which they may be moved directly to the truck without lifting by gravity roller conveyors.

Industrial trucks and roller conveyors may also be used successfully to get the goods off the trucks quickly and back from the edge of the platform, so that the next truck in line may unload without delay.

Trailers may be employed to advantage in many instances, permitting greater loads to be carried on each trip, with only a small increase in initial investment and operating expense.

Then again, besides the auxiliary equipment, it may be a combination of all three — quick-loading cranes, demountable bodies, and trailers—that will solve the problem most effectively. This proved to be the case after a thorough study of the distribution of fish over the highway, as told in the accompanying story and illustrations.

At the present moment the distribution of fresh fish for short distances by motor-truck is but the germ of an idea, which, however, must be worked out in greater detail before perfection can be reached. It has certain advantages under favorable conditions, especially at a time when the railroads are unable to move goods quickly because of terminal or other congestion. The sponsors of the plan do not claim that the motor-truck can compete with the railroads for the distribution of all fish.

Where the Motor-Truck Is Valuable

In their own sphere of long-haul shipments under ordinary conditions, the railroads are supreme. They can move fish or other goods much more economically than any other means known. For short-haul shipments, especially in periods of railroad

embargoes and other delays, however, the motor-truck has certain advantages, the principal ones of which are to get the fish delivered quickly and to save handling.

In the saving or reduction in the number of handlings, the opportunities of the truck are enhanced by the development of a new form of refrigerator body in which the goods carried never come into actual contact with ice, but are kept cool by means of cold brine circulated through pipes inside the truck body. By this body it is possible to keep a load of five tons of fresh fish at any desired temperature by the use of not more than two hundred pounds of ice a day, whereas several times this amount of ice would be required were the fish packed in between layers of ice in the usual way.

A still further reduction in the number of handlings may be made by the adoption of the demountable unit-body idea, which has been used with such great success in recent years for the delivery of groceries, paper, and other commodities.

Truck Bodies in Fishing-Smacks Save Time in Handling

The whole plan, from the time the fish are scooped out of the water in nets until they reach the table of the housewife, is shown in the accompanying illustrations. The first new idea in the proposal, outside of the fundamental one of using trucks, is to change the hatchways of the fishing-smacks between the foremast and the mainmast, so that four of the truck bodies may be carried in the boat to the fishing-banks. The fish caught, doors in the tops of the bodies are opened and the fish pitchforked directly into the truck bodies. The latter are arranged longitudinally and side by side, with horizontal partitions or shelves in them, so that the fish on the bottom are not crushed by the weight of those above them.

Since each body can carry five tons, the small fishing-smack will be able to bring home twenty tons of fish to the catch, although it is probable that a future development of the idea will result in the design of a boat that will carry eight or more bodies simultaneously.

When the catch is made off the New England coast, and it is desired to ship fish west to Buffalo and points beyond, the boats would find it most convenient to run to Boston, where there are through rail connections to the West by way of Albany. If it is desired to ship to New York, however, the boat may make some nearer port, where the filled bodies may be lifted off and shipped directly by truck over the highway.

In either case, some unloading means must be provided, such as an ordinary derrick, at the point of call, so that the bodies may be hoisted out of the hull and placed on either a railroad flat-car or a truck. The bodies are so proportioned that two of them may be loaded upon an ordinary freight platform car. Only one body can be loaded on a five-ton motor-truck, but a second body may be carried on a trailer behind the truck, so that for long hauls the total load will be ten tons.

So far, one handling is avoided, the fish having been transferred directly from the boat to the freight-car or motor-truck. Under the present scheme they would have to be first unloaded into an ice-house and then into a refrigerator freight-car or the truck body.

At the end of the haul, another handling may be saved with the new system in that the truck may proceed directly to the place of business of the consignee, or the bodies may be taken from the freight-car and put on trucks without having to pass through an ice-house. Meantime, the fish have been kept fresh without icing, and are just as good as when taken out of the sea.

Up to this point there have been no steps in the truck distribution scheme that are at all impossible. But what about returning the bodies? When salt-water fish are shipped West by rail, it is intended to use the same bodies to bring back fresh-water fish from the Great Lakes, so that the bodies will be working in both directions. This would of course be impossible with the bodies mounted on trucks that run along the Eastern seaboard; but even these bodies on the return trips may be utilized to carry canned goods, which cannot be contaminated by fish odors in the body itself.

Carrying Fish from the Sea to the Housewife

The last step in the plan to get the fresh fish to the kitchen of the consumer is to employ smaller trucks of from one to two tons capacity. From the local warehouse, these trucks may be loaded and the fish peddled from house to house.

As can be seen in the illustration on page 74, these smaller trucks may have glass-sided doors, so that the fish inside can be seen. Such a plan would help to popularize the service, since every one who saw the truck would know that it was carrying fresh fish.

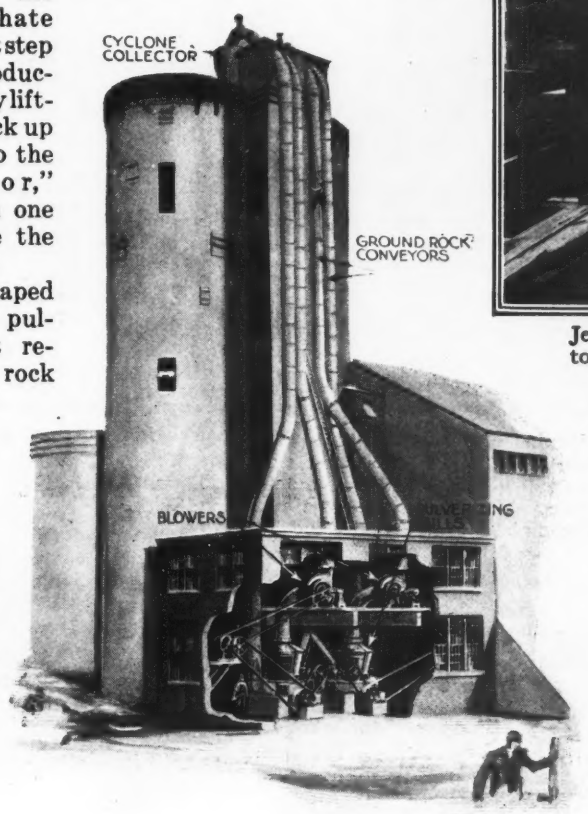
The motor-truck bodies, laden with fish, are hoisted out of the smack, placed upon the chassis of a waiting motor-truck, and then carried over the highways to their destination

A Pulverizer Plant More than One Hundred Feet High

ACID phosphate fertilizer is one of the essentials of modern agriculture. The designers of the gigantic mill shown in the picture below decided to employ gravity to convey the pulverized phosphate rock through the last step in the process of producing acid phosphate by lifting the powdered rock up through the pipes to the "cyclone collector," which is more than one hundred feet above the ground.

The bucket-shaped machines are the pulverizing mills that reduce the phosphate rock to powdered form, after which it is forced up to the top of the plant by means of several blowers.

Each of the pulverizing machines has a minimum capacity of four tons of pebble rock an hour, reducing it to a fineness that allows it to pass through a two-hundred mesh screen.



The world's largest pulverizing plant employs gravity in the process of producing acid phosphate

Jersey City's water-supply pipe, which rests on the bottom of the Passaic river, in process of construction

An Under-Water Water-Pipe

JERSEY CITY'S water-pipe line lies twenty-six feet below the surface of the Passaic river. The submerged pipe has an inside diameter of six feet and is more than four hundred and fifty feet long. It weighs about a ton a foot. How did it get there?

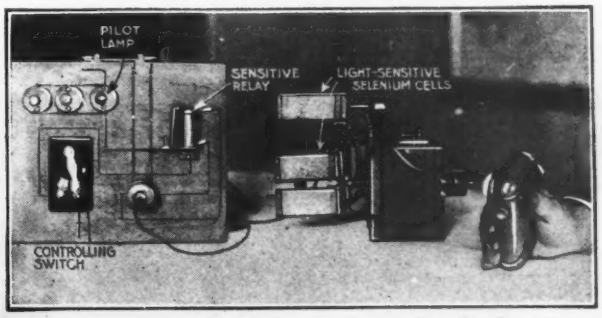
First, a trench was dug on shore and a launching-way laid on it. As the pipe was built it was supported on cars that ran on tracks in the trench. When the tracks reached the water's edge, two parallel trestles were built, and the pipe was further supported by cars that ran on top of each trestle. When the pipe was finished, it was sunk and weighted down with cast-iron blocks.

The Telephonic Eye Betrays the Burglar

THE newest foiler of burglars is the "telephonic eye," invented by Dr. Oscar Hannach.

What makes the telephonic eye so sensitive and efficient is the fact that no mechanical agency is required to operate the apparatus. The faintest beam of light is sufficient to set it working. In fact, the vital organ is a selenium compound cell of truly unequaled sensitiveness to variations of light.

It infallibly signals the presence of any undesirable visitor, as well as the outbreak of fire, at the telephone exchange or police station.



The new telephonic eye is made of selenium and is very sensitive to light changes

When a burglar enters a darkened room and operates his flashlight, or even lights a match, the telephonic eye will be affected and will flash an alarm to either the police station or the telephone exchange

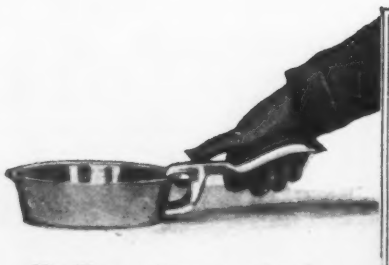
All you have to do, on leaving home, is to let down the blinds in any room to be especially protected, and to turn the switch of the telephonic eye. Unable to operate in the dark, an intruder must use a lamp or lantern. But, even if he burns only a match, the apparatus automatically throws a series of current impulses into the telephone line, thus lighting the subscriber's call, group, and pilot lamps at the telephone exchange. The telephone girl on duty notes the signal and immediately transmits the alarm to the police station.

The same apparatus, however, lends itself to a multitude of combinations and applications. An electric bell may alarm the porter or guard; a flashlight may photograph the intruder; an automatic device may, at the very moment the alarm is given, bolt all the doors and windows and light all the lamps in the house.

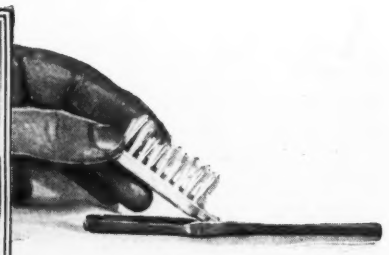
Should a mischief-maker cut the wires, he would obtain a result diametrically opposed to his intention.

The apparatus is set in operation automatically by any accidental or voluntary disturbance. The slight glow of an incipient fire obviously has the same effect as the lighting of a match or lamp, so that the apparatus is also a fire-alarm.—DR. ALFRED GRADENWITZ.

Housekeeping Made Easy



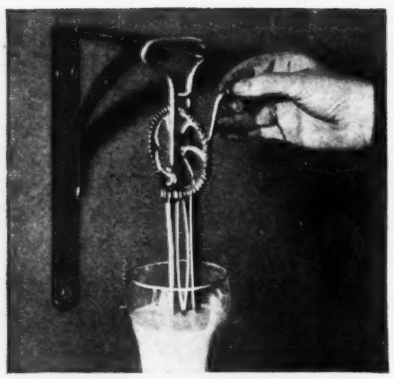
You'll never burn your hands while taking pots off the stove if you use the detachable handle shown above. The arms of it are so curved that they will grasp any pot securely



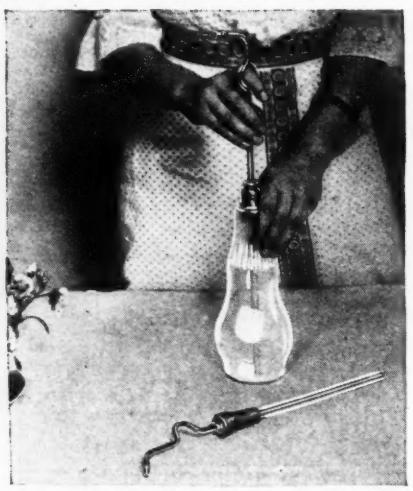
The bristles in this metal toothbrush can be taken out, cleaned, sterilized, dried, and then replaced ready for use again. They are very strong and will stand a number of baths

Many a woman has fallen and been hurt while hanging clothes on the line. Don't take any chances; buy one of these extension pulley-lines which enable you to do the hanging indoors. You can remove the extension arm when you're finished, and close the window

When you put meat into this chopper, you don't have to press the meat down with your fingers. There is a pressing lid operated by a handle. This chopper cuts and grinds



How tired your hand gets when you hold an egg-beater steadily for several minutes. Why not bolt it to a bracket on the wall when you use it?



The bulb form of atomizer has a German rival. The hollow handle is a pump which, when raised, will suck up the liquid, and when lowered will force it out

Heretofore ash-trays and smoking-stands have ignored pipes, while providing parking space for cigarettes, cigars, and matches; this stand has accommodation for a pipe

As gaslight is thrust aside by electricity, many gas-mantle protectors are without jobs. Fill one with bits of soap and attach it to the hot-water faucet when you are going to wash dishes

The carpet-sweeper is father to the new table-cloth cleaner shown here. It is made of silver, has an ebony handle, and carries a small revolving brush beneath

Keeping Up with the March of Science

Facts for the man who wants to know

How Airmen Use Oxygen

WHEN an airman ascends to heights greater than twenty thousand feet, he is sure to use oxygen. He carries it in liquid form in a vacuum tank provided with a mechanism to control the evaporation.

The liquid may be electrically heated to accelerate evaporation; or a heated rod of copper or aluminum in the liquid may be used; or the liquid may be siphoned out into an evaporating chamber from which the gas is conducted through tubes to the airman's mouth.

Flowers that Serve as Food

A REMARKABLE tree in India is known by the natives as the *mowra* and by ourselves as the "Bassia tree." Of its three varieties one produces the butter-seeds that have been much used in the manufacture of margarine, soap, etc., in Europe.

Another tree of this interesting family furnishes a flower that is rich in sugar. The natives in the central provinces use it as a regular food. The flowers of the "butter tree" are not eaten, but a syrup is prepared by boiling them down, yielding a sugar of about the quality of date sugar.

The flowers of the mowra are globe-shaped and of a pale cream color, and are collected when they fall upon the ground in the early hours of the morning. A Bassia tree will give about three hundred pounds of flowers in a year, and from a ton of the dried flowers chemists can produce ninety gallons of ninety-five per cent alcohol.

Have You Euphoria?

IT takes a doctor to give a high-sounding name to a well known phenomenon. "Euphoria" means "feeling fit." It is as much a physiological fact as scarlet fever.

Nature makes it worth while to be alive simply through euphoria. The joy of making a good tennis stroke, the delight that a woodsman gets in the open air, the artist's rhapsody—all are due to euphoria. Why do we drink alcohol—when we can get it—or smoke tobacco? To affect euphoria. When a lunatic thinks that he is Napoleon and demands the homage due an emperor, he has euphoria in its worst form.

Too little is known about euphoria. Since it can be affected by drugs and chemicals, who knows but it may have its seat in some gland?

A Rival of Acetylene

A NEW gas has been developed from the manufacture of alcohol which can be compressed to 3500 pounds to the square inch and stored safely in steel tanks. It has a pleasant odor and has no harmful effects of its products of combustion, and it also gives better cutting results through thick metal.

The high temperature reached by a flame of gas used for cutting metal depends largely upon the power of the gas to liberate heat faster than it is absorbed and conducted by the metal to be cut. Of course, the gas must have also a high heat-value, which it is able to maintain. Carbon, not retarded by some other element in the process of cutting, is the chemical agent in a gas which produces the most rapid combustion.

The successful cutting gas should contain a large percentage of carbon, should be unsaturated, should be combined with the lowest proportion of slow-burning gas, and should have a high rate of combustion. The new cutting gas meets these conditions second only to acetylene. It is obtained from processes in the manufacture of alcohol. A temperature of 6200° F. can be reached with the new gas, compared with 6300° F. for acetylene.

What New York Eats

FIFTY thousand cars of eight leading fruits and vegetables are consumed annually by the seven million people who live in the metropolitan district. These cars would make a train three hundred and seventy miles long—from New York city to Rochester.

New York consumes about fifteen per cent of the total quantity of apples, potatoes, cabbage, onions, tomatoes, strawberries, cantaloups, and peaches shipped each year.

In the four years from 1906 to 1909, inclusive, 195,354 cars of these products were received at New York terminals. This is a yearly average of 48,838. These quantities do not include the vegetables brought into the city by trucks.

Coal-Mine Explosions

THE power lines that supplied one of the mines in the Pittsburgh district needed repair, and in consequence the mine shut down over Sunday. In the meanwhile the lines were repaired. As soon as the power was restored the ventilating fan was turned on, and shortly afterward the switch that controlled the underground sections was thrown in. There was a deafening roar—the gases in the mine had exploded!

The cause of the explosion will always remain a mystery. But it seems probable that a short circuit on one of the lines caused a spark when the power was switched on. The gases that had accumulated while the fan was not in operation readily ignited.

Keeping the Subway Dry

UNDERGROUND passages are always difficult to keep dry. Water from various sources seeps in. In New York a large sum of money is spent yearly to keep the subways dry. Automatic electrically driven pumps are used.

Water that leaks in collects in a sump which is provided with float switches. When the water in the sump passes a certain level, the float switch closes the electric circuit and the motor is started.

Where the subways pass under the river, emergency motors connected to high-capacity pumps are used to prevent flooding. These pumps are also automatic in their operation.

Earthquakes in Panama

FOUR hundred and fifty-seven earthquakes were recorded by automatic instruments installed in the Canal Zone from 1906 to the end of 1909. This is not so alarming as it may seem. Even a Northern city like New York has its tremors every year, although they are too slight to be felt.

The most important disturbances, as far as the Isthmus of Panama and the Canal are concerned, are those that originated less than two hundred miles away; but these no one noticed.

Tin, an Abused Word

TIN is a loosely used word. Sheet metal of any kind is usually referred to as tin—from "tin" cans to "tin" lizzies.

Pure sheet tin is not in general use, and never will be, because the metal is not abundant enough. The tin cans used to hold food-stuffs are really made of sheet iron. Iron itself rusts when exposed to oxygen. Tin is not affected in this way. To make sheet iron cans safe to use, they are immersed in a bath of molten tin. In this way a thin film of tin is caused to adhere to the iron, protecting it from rust.

At present tin sells for about ten hundred and fifty dollars a ton. If cans were made of tin they would be too expensive for general use.

The Poisons of Animals

MORE progress has been made in studying plant poisons than animal venoms, obviously because plants are fixed and can be gathered in great numbers. As many as twenty thousand serpents had to be captured by a single explorer in order to obtain enough venom of the species to make all the analyses required. Similarly, the examination of bee poison means the capture of 200,000 bees and the isolation of their venomous juices.

As a result of these modern researches, it is now concluded that there are two great classes of animal venoms—those that contain nitrogen, and those that are free from nitrogen. There is a close resemblance between non-nitrogenous plant and animal poisons. Cantharides ("Spanish fly") is found in a few bugs and in some plants. Some serpent poisons find their chemical counterpart in plants.

It has been proved that animal poisons do not belong to a new class of chemical

compounds. Some day they will be made artificially in the laboratory for medicinal purposes. In some snakes a venom is found, for instance, that has an effect on the heart like that of digitalis.

Making Garbage Profitable

IN these days of strenuous conservation New York city calmly spends three million dollars a year for dumping five million dollars' worth of garbage into the sea. And yet, methods of garbage reduction have been improved until now it is possible to obtain a high percentage of valuable products from garbage.

It will yield at least four per cent of grease and fifteen per cent of tankage. At present prices grease is worth about fourteen cents a pound, and tankage is worth fifteen dollars a ton.

If New York would build a reduction plant, garbage would become profitable.

Oil from Corn

FEW people know that corn contains oil. A valuable cooking oil is now being recovered from corn. It is really a by-product of the manufacture of certain stable corn products.

With the great corn crops in this country, tremendous quantities of corn oil can be manufactured. This oil is a very good substitute for cottonseed oil. Many bakers now use cottonseed oil because the production of corn oil fluctuates.

How Lightning Kills

NUMBERS of cases of death by lightning have failed to reveal any direct effect of the passage of an electric current through the human body. The evidence indicates that death was caused entirely by shock. The result is psychological rather than physical, the shock inducing heart failure or other organic disturbances.

Sometimes strokes have been fatal to a mother although the child in her arms was unharmed. Persons under the influence of a drug or intoxicated seem to escape. This seems to indicate that the psychological element is an important consideration.

Making Soles of Rubber

THERE are about one thousand shoe manufacturers in this country, and their average daily output of shoes is rated at more than two million pairs. What a huge supply of leather is demanded, if all of these shoes are to have leather soles! But in the past five years attempts have been made, with more or less success, to find a suitable substitute for leather. Soles made of fiber and rubber, molded to the desired shape, give the most promising results.

It is estimated that there will be a daily demand for at least 686,466 pairs of rubberized soles, if the desires of the public are met by enterprising manufacturers. Only about three and one half per cent of this demand is now being met.

Various fiberized soles have already demonstrated their worth, both in army and in civilian life. The man who would walk on a smooth roof without slipping, who would climb rocky ledges, and who would find comfort in walking can testify to the value of the composition sole compared with that of leather.

Noxious Gas in Mines

WHEN an explosion occurs in a mine, there is often the urge of immediate rescue of men who have been imprisoned. Following the catastrophe, some parts of the mine become choked with noxious gases, and through these the dangerous trail of the investigating party may lead. It is then necessary to equip the men with an oxygen-breathing apparatus, and the maximum distance that can be traveled with the best supply is five thousand feet. That is, one can travel safely two thousand five hundred feet and back on a level stretch unencumbered by obstructions.

But danger lurks for the men who try to go farther than their limited supply of oxygen will permit. Three miners were recently killed in trying to travel two thousand four hundred feet on a supply of oxygen that was intended for a duration of forty-five minutes. The slope down which they lugged the forty-pound apparatus had a twenty-five-degree incline. They probably made good time going down, but the climb back with their heavy outfit was too much and the supply of oxygen was exhausted before they could reach fresh air.

Are There Other Universes?

IS there one great universe at least ten times larger than was formerly believed, or are there numbers of island universes similar to that to which the sun belongs? Astronomers are seeking the answer. Some contend that the Milky Way contains virtually all of the stars, star clusters, and nebulae, forming a gigantic circular disk 30,000 light-years across and 3000 light-years thick. Light travels 186,000 miles a second, so that a "light-year" is an enormous distance.

Modern investigation seems to indicate that there is a galaxy of stars ten or more times larger than the Milky Way, and that beyond this galactic universe can be dimly seen, through the largest telescopes, innumerable other "island" stellar systems. These distant universes are so remote that only a mere trace of them can be discerned.

Fruit Butter by Vacuum

WE are all more or less familiar with apple butter; but apricot, peach, quince, and grape butter are known only to those of us who have lived abroad. European immigrants coming to this country hanker after these fruit butters, and the demand for them has led to the development of a new vacuum process for making them.

Undersized or overripe fruit is used for the purpose. It is washed, crushed, pitted, and then sent on to finishers, who remove the skins and tough fibers. The resulting pulp is diluted with water, and is pumped into storage-tanks, whence it is fed to a spherical vacuum-tank.

The tank is filled and then closed. Steam coils within revolve and agitate the watery pulp, while small brushes attached to the coils scrape the bottom to prevent burning. Because of the heat the water constantly evaporates and the butter forms. The vapor passes off through a pipe at the top of the tank and the butter is drawn off at the bottom.

The Crows in Oklahoma

THE cawing black crows prevalent in Oklahoma during the winter have recently been the subject of extensive investigation to determine the extent of the damage they do.

It was found that during the fall and winter months the birds feed principally upon grain, peanuts, and pecans, when these are available. At other times animal offal, weed seeds, and insects are their diet. It is estimated that at least ten million crows remained in the state during the winter, and that one bushel of grain daily was consumed by each thousand of the birds. This makes a grand total of $1,200,000 loss in grain during the winter months.

A number of methods of getting rid of the birds have been contemplated, one of which is shooting them as a winter sport.

On Which Side Do You Sleep?

ACCORDING to Professor Hans Guenther, 23.5 per cent of us sleep on the right side, 22 per cent on the left side, and 14.5 per cent on our backs. When we lie prone on our abdomens, it is, as a rule, because we are sick. The same holds true for other unusual positions.

Why do most of us sleep on the right side? Probably because the stomach can empty itself better in that position.

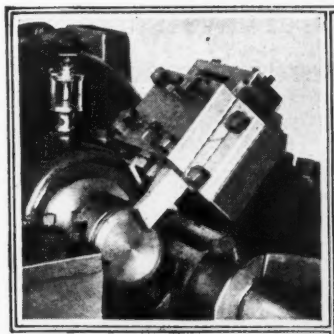
If the habit is formed of sleeping on one side, it is probable that in time the body will lose some of its symmetry. Barbers know that the growth of the hair on the head and the chin is retarded on the sleeping side, presumably by pressure.

A Prehistoric Niagara?

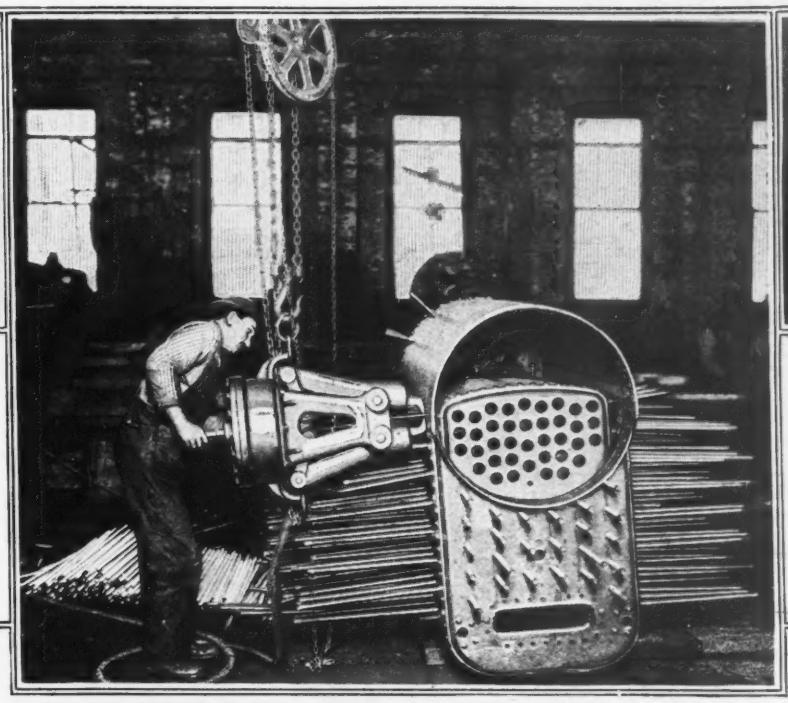
ENGINEERS conducting the work of excavation for the new Welland ship canal have unearthed what seems to have been a prehistoric Niagara. The ledges that have been uncovered in a width of 400 feet are in steps of about 25 feet total drop. Then for one hundred feet the rock has a sharp downward slope to what must have been the brink of the ancient waterfall just seventy-five feet below the crest of the uppermost ledge. At this point the great current leaped into a chasm hundreds of feet below.

Unmistakable signs of wearing through the action of water are indicated by the surface of the rock. For countless centuries this prehistoric Niagara must have cut its passage from Lake Erie to Lake Ontario, and then for countless years must have remained buried under the accumulation of ages.

Multiplying Man's Power by Machinery

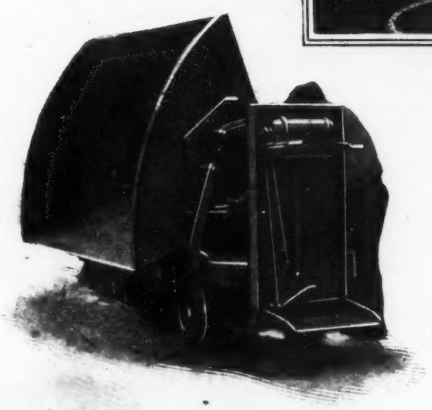


This automatic lathe, with one setting up of a pair of magazine tool-holders, will make as many cuts as would five machines with but one cutting-tool each

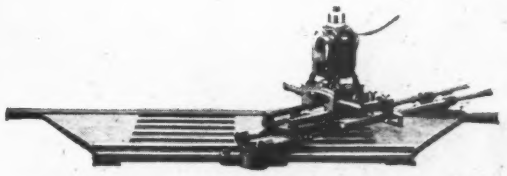


With this staybolt cutter one man can do the work of twenty-five men cutting off staybolts with chisels and hammers. In an hour it will clip 1200 bolts to the right length. It is perfectly balanced and its position can be changed by a touch of the operator's hand

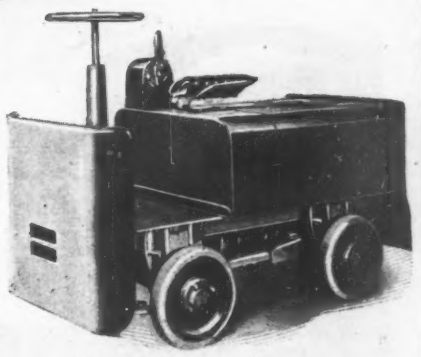
Placed in position, this automatic lubricator for the flanges of locomotive or car wheels will protect them and the rails from excessive wear in rounding curves



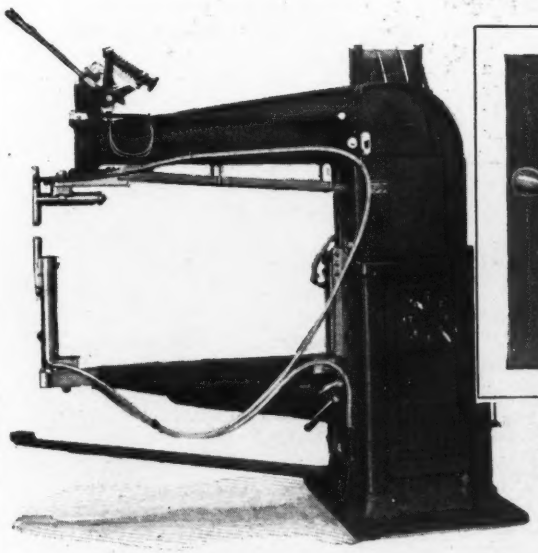
Two men operating this dumping-truck of forty-three cubic feet capacity handle as much coal in a given time as was formerly handled by six laborers, each using a wheelbarrow with four cubic feet capacity



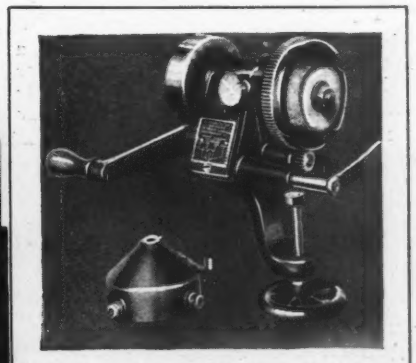
This electrically actuated routing machine is employed for cutting the grooves for steps, shelving, window-frames, and other purposes. It does as much work in a given time as a small army of men with saws and chisels



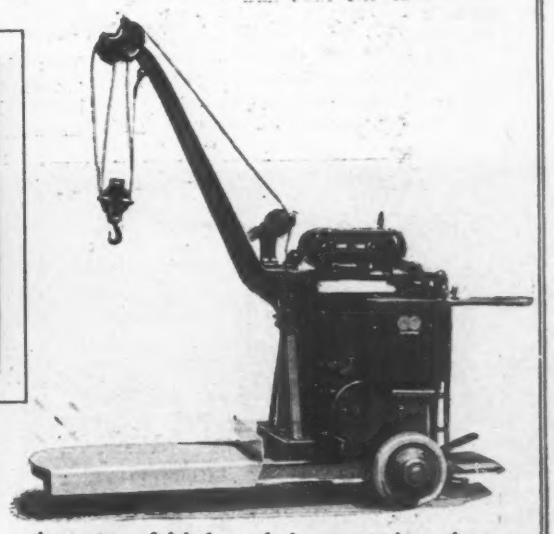
What the yard locomotive is to the freight-yard of a railroad, a truck like that shown in this picture is to the factory, shop, or freight depot. It is strong, easily operated, practically foolproof and will haul big loads



Spot-welding machines were introduced during the war rush at the shipyards. They increased the production of ventilator cowls



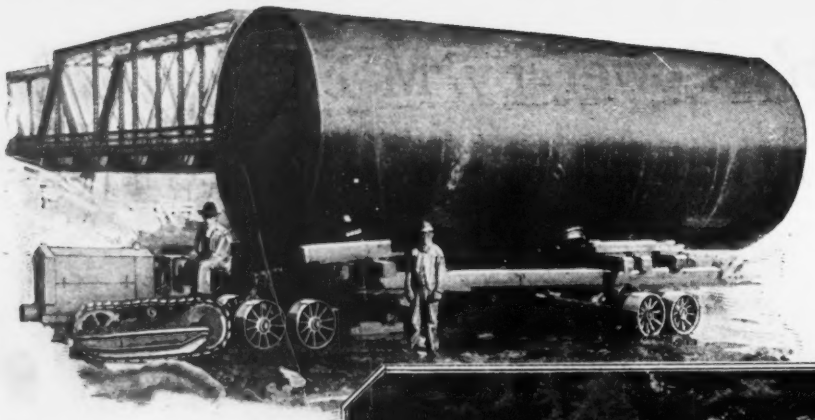
Automobilists will be interested in this new timer grinder driven by hand or engine power. It weighs only seven pounds and may be easily attached either to a shop bench or to the running-board of an automobile



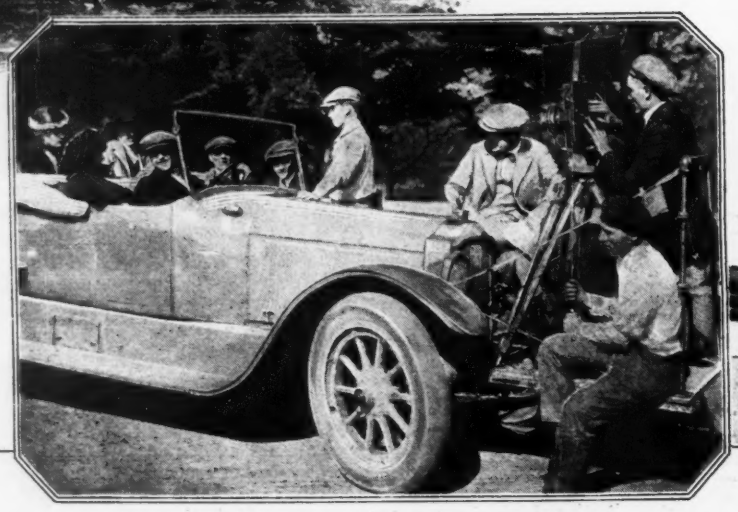
A most useful help and time-saver in a shop or mill, especially where heavy loads must frequently be moved, is a platform truck, equipped with a small, powerful crane operated by a small motor

Do You Own a Car?

There is always something everywhere inventors are



It seems almost incredible that the small caterpillar tractor shown here could pull the truck loaded with a huge ten-ton tank over rough ground; yet it accomplished that task, apparently without the slightest difficulty



Here is shown how close-ups of automobile scenes are made with the motion-picture machine. The operator is placed with his camera on a platform in front of the radiator

This grease-cup has no detachable parts to lose. The spring-metal plunger exerts a uniform pressure and makes the cup suitable for grease or oil

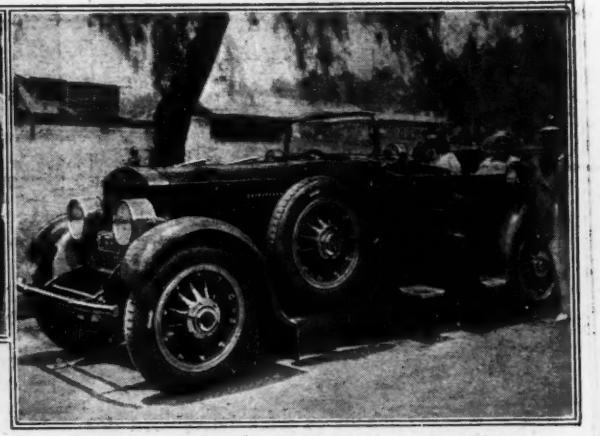
Take a test-tube of glass, put in it a few discarded phonograph needles and some gasoline, and you have a spark-plug cleaner. Put the plug against the opening of the tube and shake it

This tiny automobile, the property of a "movie" star, is probably the smallest ever built. It has a twin-cylinder motorcycle engine and can make eighty-five miles an hour

Carry a small horseshoe magnet in your tool-box. It is very convenient to hold your small trouble lamp on motor, fender, hood, or any other steel or iron part of your automobile while making repairs

Throughout Great Britain gasoline—or "petrol," as it is called there—was until recently obtainable only in two-gallon tin cans like those shown in the picture. Americans are now introducing modern tank stations

With the extension tire-rack attached to the one-tire rack furnished with your car, you may carry either one tire or two on the rear of your automobile



How much did you pay for your car? Never mind how much! Now, look at the magnificently equipped automobile shown in the picture. With all its accessories, it cost its owner a trifle more than $25,000

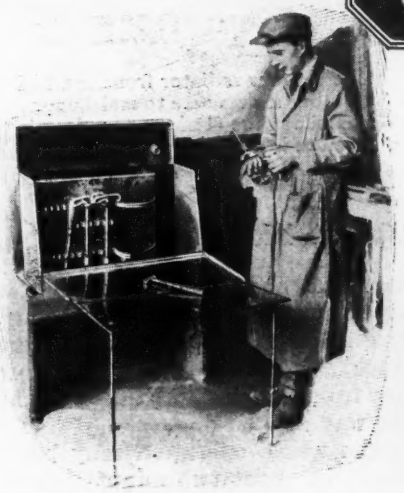
Find New Ideas Here

new in the automobile field; contributing novel features

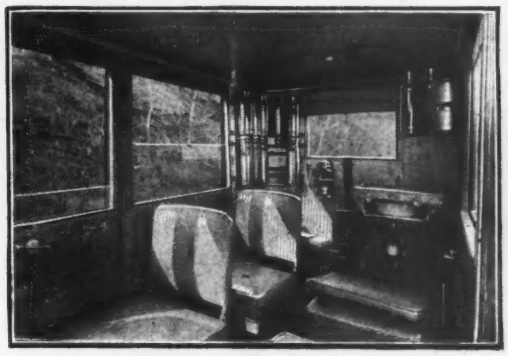
In an industrial parade in the Middle West this truck, with its unusual load, created great interest. It carried a half-size model of a freight-car, complete in every detail, resting upon a miniature track

This fan-belt is made of fiber, leather, and metal. The links of fiber and metal bear the strain of the pull, while the leather takes care of the friction

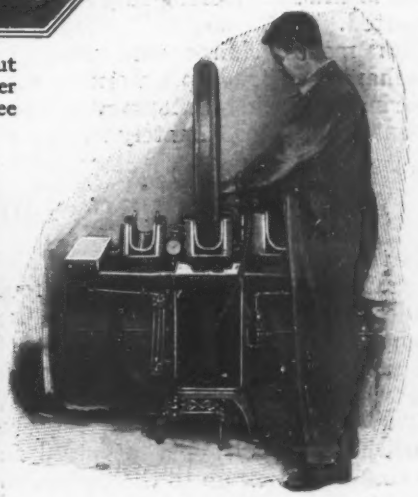
You may think it safe to do a little speeding, but don't do it. There may be a motorcycle officer watching for offenders from behind a wall or tree with a periscope



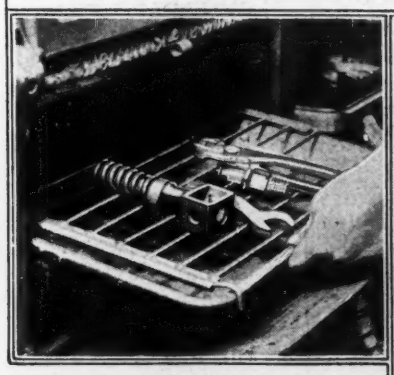
A tool-chest that may be carried on the running-board of the automobile. When opened, its door, supported by braces, forms a convenient work-table



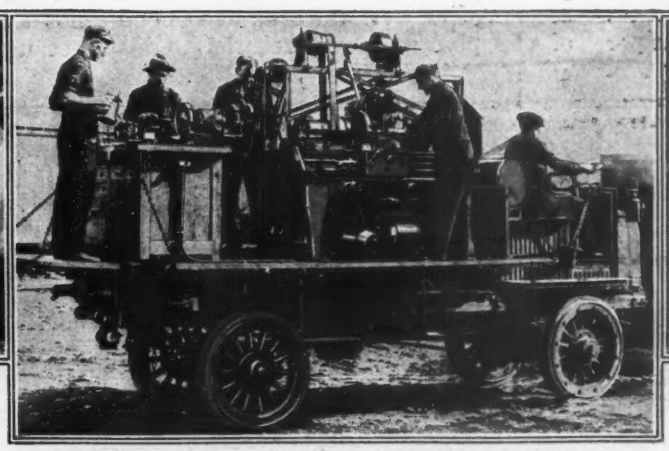
All the comforts of home, including sleeping quarters, kitchen, pantry, and sitting-room, are combined in this automobile equipped for overland tours



This picture shows a new tire vulcanizer recently placed on the market. Its construction is unusually simple, yet the apparatus is effective and durable

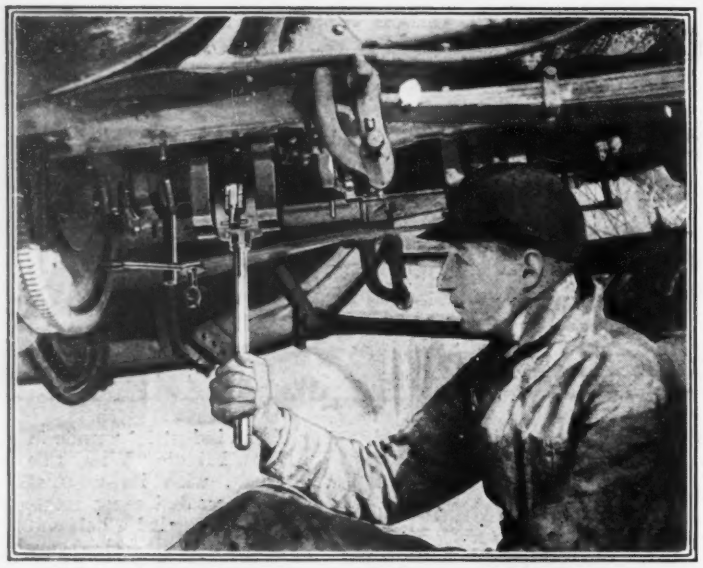


Tools that have become greasy and dirty, when used in repair work, may be quickly cleaned by placing them on the grating of an oven and burning off the grease



Here is an emergency repair-truck, equipped with lathe, drill-press, grinder, welding apparatus, forge, a separate motor, and all necessary tools; it is used by big concerns to repair trucks that have become disabled

When this automobile lock is closed, it fastens the gears in reverse position and clamps on the emergency brake. The car can neither be driven nor towed without breaking the lock



With this hand reamer you can true up the bearings of your crankshaft on the road if necessary

An Emergency Reamer

EVERY automobile repairman has a demand for a portable tool with which crankshaft bearings may be trued up in an emergency in the car or on the bench. Truing up a set of crankshaft bearings by turning on a lathe is a more costly and slower method.

The hand reamer shown in the illustration consists of a handle and split locking-ring in which the cutting tools are inserted.

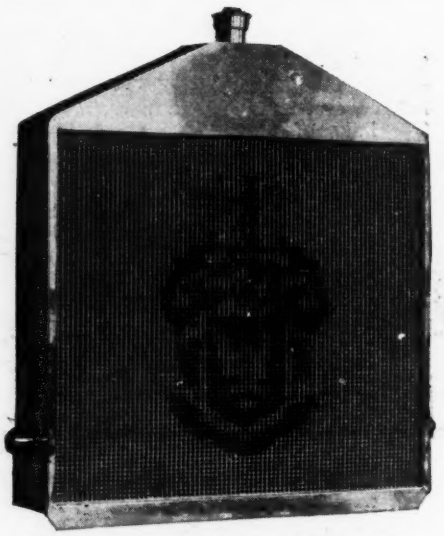
Its maker claims that with the tool an average mechanic can true up a worn or out-of-round crankshaft bearing to within an accuracy of less than one thousandth of an inch in approximately twenty minutes.

Watermarking the Radiator

AMONG the newest innovations in the marking of automobiles for identification is a "watermarked" radiator. The process by which the watermarking is accomplished was invented and patented by L. G. Hanmer, of New York city. The watermarking is done by increasing the size of certain predetermined cells in the radiator by an expansion process after the cell structure has been assembled ready to be dipped into solder. This difference in the sizes of the cells gives the impression of the light and dark cells that make up the trademark or monogram. In the actual expansion of the cells, only the front half inch or so of the cells is expanded, the remainder or back half of the radiator structure being entirely homogeneous.

Under certain light conditions and from certain angles, the watermark is scarcely discernible, while under other conditions it appears very clearly.

One is enabled to judge for himself of this alternate visibility and invisibility of the watermarking by moving the illustration quickly from one angle of vision to another at different distances.



Have your radiator front marked like the one shown here to make your automobile more attractive and easier for you to identify

Saving Time in Coupling Tractors and Trailers

IN the four-wheeled trailer the entire trailer load is carried on the four trailer wheels, with none of the trailer load supported on the framework of the pulling vehicle, as is the case with the two-wheeled semi-trailer.

The loss of time in connecting the four-wheeled trailer has occurred in backing the truck up to the trailer, so that the bolt or jaws of the connecting drawbar might fall or lock into place. This operation has required two men, the truck-driver to back up his truck, and a helper, to guide together the drawbar attached to the trailer with the locking member on the truck. There was always danger of the helper being mashed between the rear end of the truck and the front end of the trailer if the driver were careless or there was any misunderstanding as to signals.

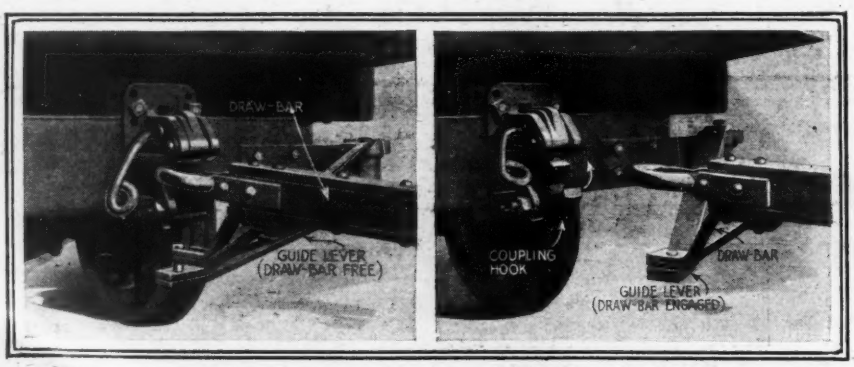
Both of these objections can be overcome by the adoption of a new form of safety coupler, as shown in the accompanying illustrations. The new feature of this coupler is a lever pivoted to one side of the truck frame at the rear. The length of the lever is such that when it is swung toward the center of the truck, it carries whatever is fastened to it directly into the jaws of the waiting coupler.

Instead of having to back his truck to within an inch or two of the forward end of the trailer drawbar, and then have a second man make the connection, the driver merely backs his truck to within twenty inches of the proper coupling distance. Then he dismounts, places the front end of the drawbar coupling link over the stud at the end of the pivoted lever, returns to his seat, and backs his truck. The lever automatically carries the coupling link into the jaws of the coupler on the truck, which lock. The lever is thrown free from the coupling and held out of the way by a spring.

The whole operation may be completed in about two minutes' time by the truck-driver.

While the ability of any wheeled or other vehicle to pull more than it can carry is well known by the every-day examples of the railroad train or the tug-boat, the application of this principle to the motor-truck and trailer has not always worked out satisfactorily because of the loss of time in connecting and disconnecting.

This problem has been solved in the case of the semi-trailer by the adoption of the self-centering fifth wheel and similar devices. It was not, though, until the advent of this new coupler that any apparatus had been devised to cut the loss of time in connecting and disconnecting a four-wheeled trailer.



When the coupling is completed, the drawbar is automatically disconnected from the guide lever

This shows the drawbar engaged in the lever which guides it to the coupler

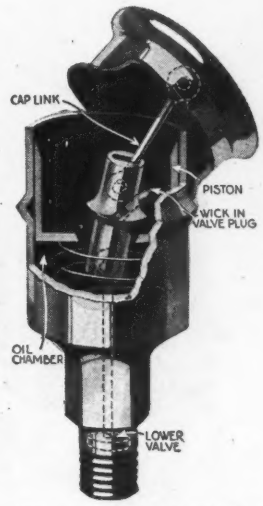
This Oil-Cup Works Automatically

ONE of the latest designs in oil-cups is automatic in operation and yet occupies no more space than the ordinary grease- or oil-cup. The cap is hinged, not to the side of the cup, as might be expected, but to a central valve inserted in a cup-shaped piston.

In outward appearance the cup is much like any other. As soon as the cap is removed, the difference becomes apparent.

When the cap is opened, the piston is forced upward by a coil-spring underneath. This unseats the center valve and permits oil to be injected into the space below the piston from an ordinary oil squirt-can. When the cap is closed, the piston is forced downward against the compression of the spring by the center valve by reason of its being hinged to the cap. This forces the oil down into the bearing to be lubricated at a pressure of between two hundred and three hundred pounds to the square inch, or sufficient to force all foreign matter from the bearing.

The oil is automatically fed through the center valve by a felt wick at the rate of a few drops a day, thus assuring constant lubrication, even though the cup is not touched from the time it is first filled until it has become empty.



When the cap is opened, the oil reservoir can be filled. When closed, it feeds oil to the bearing automatically under pressure

In one minute you can change your touring-car to a limousine, protecting you from wind or rain

A Convertible Automobile Body

A PROMINENT English aviation expert has developed a unique type of convertible automobile body. This body is simplicity itself. Aside from a folding top, the rear quarters of which are closed, it has a three-section glass part that completely encloses the sides of the body, when unfolded. This glass portion folds into the space of the center section, just as the familiar triple mirror does, and then the three plates swing down into a compartment provided for them in the side of the body between the doors. When unfolded, each glass panel fastens securely in its respective position, the side sections to the doors and the central part to the top.

It is claimed that the transformation from open to closed form or *vice versa*, can be accomplished in about sixty seconds.

The Paving Machine with Caterpillar Traction

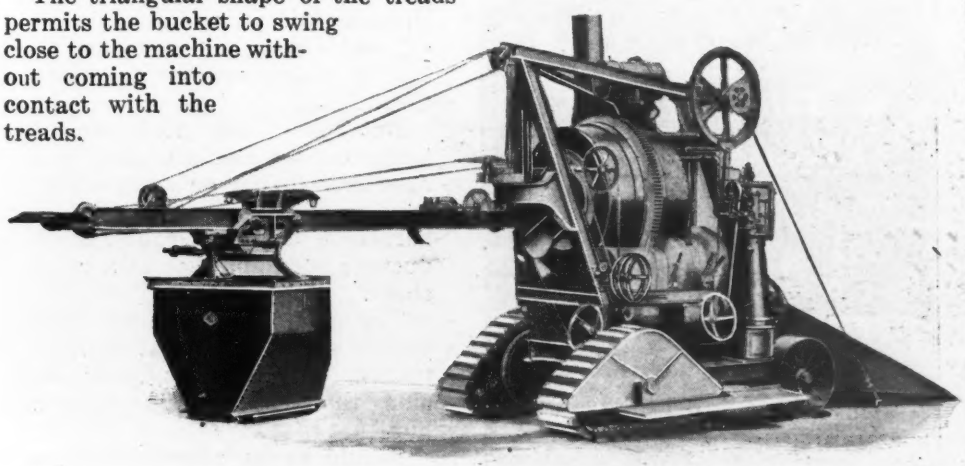
THE latest adaptation of the caterpillar type of creeping tread to a commercial product is on a street-paving machine. Because the creeping tread is interchangeable with the ordinary wheel traction, the machine takes on a dual purpose in that it can be used in countries having alternate dry and wet periods.

The change from one form to the other may be made readily.

The creeping tread is of the triangular type with three wheels inside, two at the ends and one in the center at the top, where it serves as a tightener.

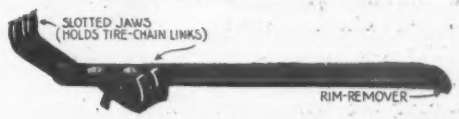
The triangular shape of the treads permits the bucket to swing close to the machine without coming into contact with the treads.

This combination tool may be used for tightening automobile chains or for removing a tire-casing from its rim



This new type of street-paving machine can be changed from a wheel drive to a creeping-tread drive in a few minutes

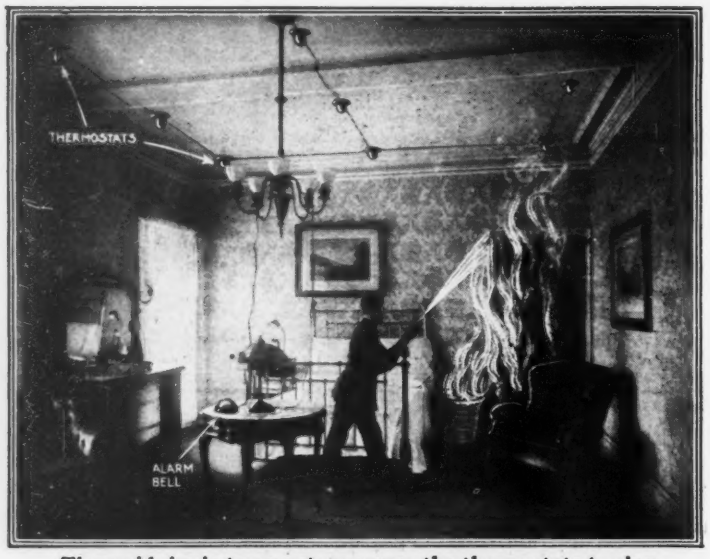
The Tool that Tightens Anti-Skid Chains



SOMETIMES, when a motorist has put his anti-skid chains on the tires of his car, he finds it a most difficult matter to close the two ends of the chain without getting out every screwdriver or pair of pliers he has in his toolbox. This is because the chain must be stretched evenly around the tire and fitted fairly snugly before the snap fastener can be closed.

The new tool shown herewith was designed for the very purpose of making this task easier. It consists of a handle with two pivoted jaws at one end. The ends of the chains are slipped into the slots in the ends of the jaws, and the handle given a twist, when the two ends of the chain are brought together for easy attachment.

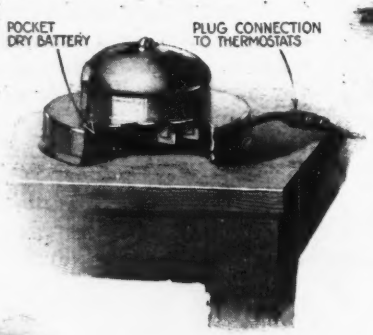
Aside from this use of the tool, the curved end of the handle may also be employed to remove a tire-casing from its rim.

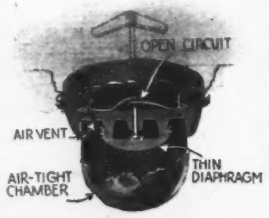


The rapid rise in temperature causes the thermostats to ring a bell before a fire in the room gains a dangerous start

Trapping Fires Automatically

AGES ago primitive man worshiped fire. In the world to-day there are the remnants of a fire-worshiping race, but to the civilized world fire is both a blessing and a curse. When it gets beyond the control of man, it is a demon of destruction. Ten thousand lives and $250,000,000 in property are annually sacrificed to the fire demon in the United States. Another $250,000,000 is annually spent to keep up the necessary apparatus to fight fire.





The heat inflates a thin diaphragm that closes an electric circuit, which rings a bell. The ordinary heating of air in a room will not cause false alarms

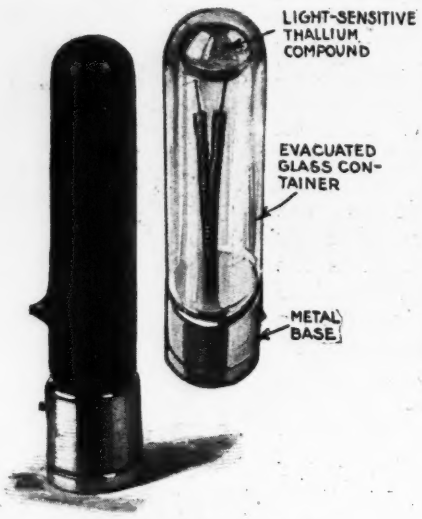
A spark, scarcely visible, may start a conflagration that will sweep away a whole city. A fire detector that promptly sounds the alarm would enable a quart of water to accomplish what scores of powerful streams from the hose might fail to accomplish a few hours later.

An automatic fire-alarm that works upon the principle of the rapid increase in temperature due to a fire in the room, instead of depending upon sufficient heat to cause the fusion of soft metal alloys, has proved itself valuable in giving notice of a fire before it gets beyond its easily extinguishable stage. Ordinarily a fire-alarm depending upon alloys, soft solder, bimetallic compositions, etc., requires a rise of temperature of from 110° to 250° F. By the time a fire has raised this degree of heat it is an agent of destruction.

With the instrument shown here, the burning of a newspaper in a room having a floor space of five hundred square feet is sufficient to cause the alarm to be given. It operates the instant the air close to the ceiling becomes heated at the rate of 4° F. a minute.

Insulator in the Dark—Conductor in the Light

AN insulator is a substance that will not permit the passage of an appreciable amount of electric current. A few substances are perfect insulators in the dark, but when light falls upon them, their electrical resistance changes rapidly. In some instances, current is allowed to pass with perfect ease. Such substances are said to have photo-electric properties. The element selenium has very marked photo-electric properties. When it is caused to form part of an electric circuit, no current will flow while it is in the dark. Immediately a light falls upon the selenium, its resistance is lowered and current flows. Advantage has been taken of this property in the perfection of burglar alarms and the transmission of photographs over wires.



The light-sensitive thallium compound is mounted in a glass tube. It is far more sensitive than selenium and should prove of great value in studying faint variable stars

A substance has been discovered that is far more sensitive photo-electrically than selenium. This substance has been called thalofide. It is composed of the elements thallium, sulphur, and oxygen. It was discovered by T. W. Case, a physicist, living in Auburn, New York. The thalofide is mounted on a quartz disk and placed in an evacuated red glass bulb. So sensitive is this cell that its electrical resistance will drop fifty per cent when it is exposed to a light source of one candlepower at a distance of one foot. If its resistance were ten thousand ohms in the dark, it would fall to five thousand upon exposure to this small amount of light.

He won't be hurt if he is thrown off the step. He is harnessed to the car

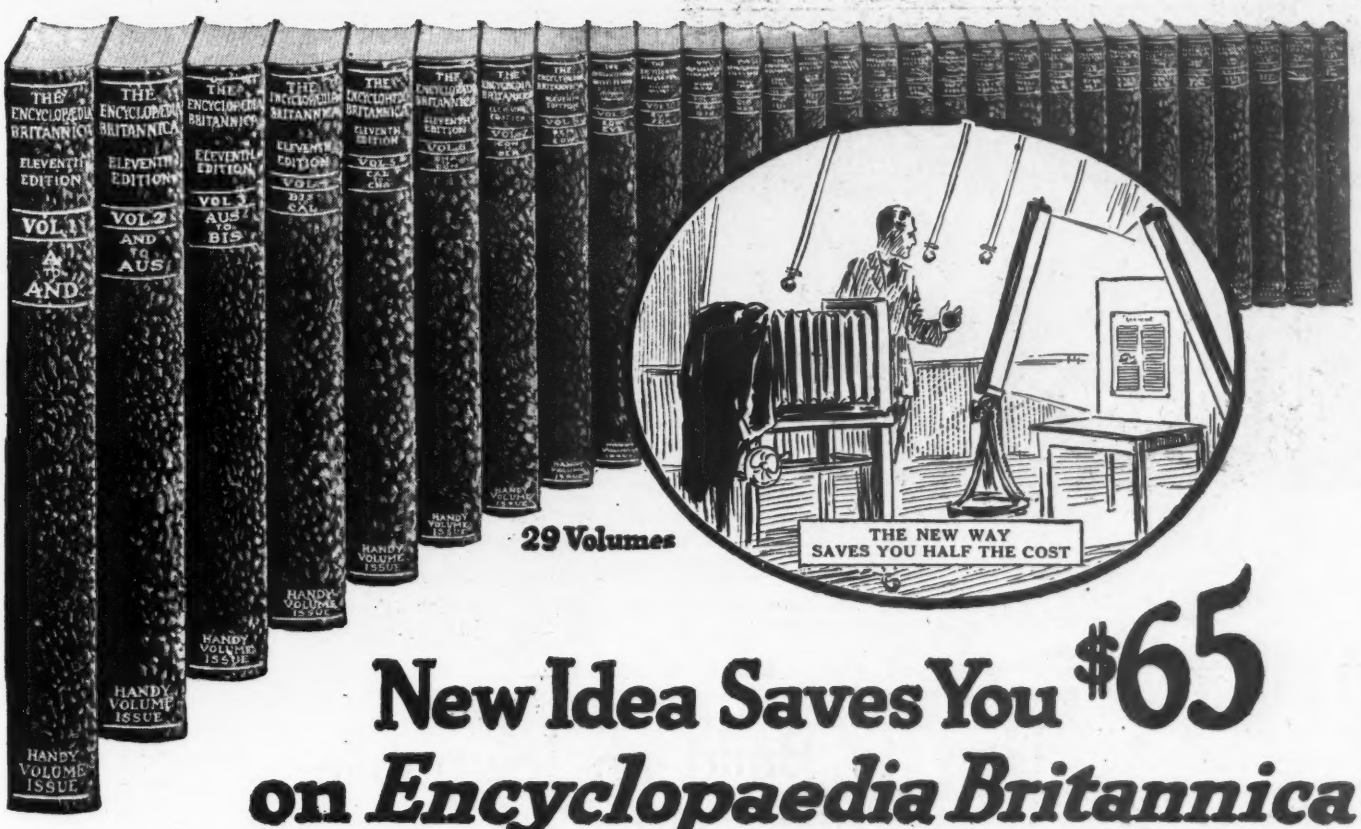
Harnessed to His Car, He Won't Fall Off

IF you are a trolley-car traveler, you will appreciate the hardships and risks of a conductor's lot. He must climb around a step full of people to collect his fares, hold on by one hand, and constantly run the risk of being thrown off.

But John Udall, of Weston, Ontario, has invented a protective harness that should do away with the dangers of a conductor's job. This harness is strapped around the conductor's body and then attached to a chain.

The chain has a small carriage at its upper end that moves in tracks. As the conductor walks along the step the chain moves with him.

Should he be hurled off the step, he will swing at the end of the chain and remain unharmed.



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Gliding over the frozen and smooth surface of a large pond, lake, or river with lightning speed in a sled with motor-driven propeller is a fine winter sport indeed equally delightful for young or old

How to Build an Icemobile

Make your iceboat independent of the fitful power of the wind

By L. B. Robbins

THE ice-yacht is in its element in a brisk wind; when the air is calm it has to remain at a standstill. That is the one disadvantage of sail-propelled boats operating upon either water or ice. But for the man who can procure a small engine, the freakishness of the elements can be discounted, and high speed attained upon the ice—"blow high, blow low." Independence from atmospheric conditions adds to the pleasure derived from this sport.

A typical ice-boat body is used for the foundation of this icemobile and an air propeller is utilized to drive it. The air propeller is used for many reasons: because it eliminates the problem of traction upon the ice, gear-shift and differential complications, and offers a simple means of driving directly from the engine. With a propeller of suitable proportions and an engine capable of giving sufficient speed, much exhilarating sport may be enjoyed on smooth ice.

Common sized lumber and standard iron pipe, as well as the standard Ford supplies and specifications, are designed to be used throughout. This means that the cost is kept low and parts are readily obtainable. The engine is the only costly part. But if the second-hand automobile market is watched closely, engines possibly past road usefulness may be purchased at a trifling cost. They may be used in this craft to advantage, in spite of small defects that would render them undesirable as automobile engines. Of course, the better the engine, the better the results.

The drawings are made to the specifications of a Ford engine, but any other engine may be used. The engine-bed and power-transmission arrangements will have to be altered somewhat. However, this is not difficult.

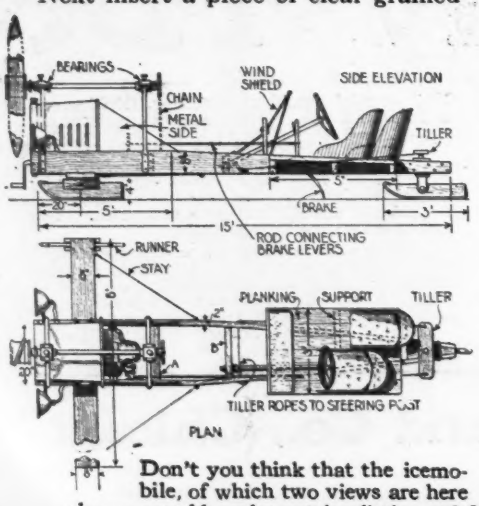
It is best to purchase the propeller, as most amateurs will find it a surprisingly difficult task to make one.

The Backbone

This is the foundation of the entire craft and also serves as the engine-bed.

The main part is composed of two lengths of clear spruce or white pine 15 ft. long, 8 in. wide, and 2 in. thick. Five ft. from one end, taper the two pieces down to the opposite end, so they measure 4 in. wide.

Next insert a piece of clear grained oak or ash 20 in. long by 3 in. wide by 2 in. thick between the two 8-in. ends of these backbone timbers, and secure it by two 8-in. lag-bolts inserted through the sides of each timber. The oak piece should come flush with the bottom edges of the long timbers. Reenforce their union by bolting a metal plate to each piece at both sides (underneath). This is shown in Fig. I, and leaves a space for the radiator 5 in. deep.



Don't you think that the icemobile, of which two views are here shown, would make a trim little craft?

Five feet in the rear of this front cross-piece insert a second piece *A* 20 in. long and 8 in. wide, fastened by lag-screws in the same way.

Now cut out a wedge-shaped piece of hard wood 2 ft. long and of suitable shape to fit between the 4-in. ends of the two sides when they are sprung together against it in the rear. The small end of the wedge should be about 2 in. thick. Bolt the sides to it as shown.

Three feet back of timber *A* insert a third piece (*B*) of hard wood 8 in. wide and 2 in. thick and long enough to spring the sides out in a gentle curve toward the rear without forcing them apart between the two front cross-pieces forming the engine-bed. Use lag-screws to fasten this also.

Bore a 1-in. hole in the wedge block 18 in. from the rear end for the rudder-post to rotate in.

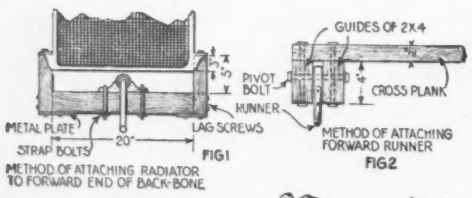
Next build a platform of matched boards 5 ft. long and 3 ft. wide upon the rear of the backbone. Lay this lengthwise and support it by three cross-timbers of 2 by 3 in. mortised into the top edges of the backbone timbers so as to lie flush with their top edges. The rear end of the platform

Kodak as you go.

Eastman Kodak Co., Rochester, N. Y., *The Kodak City*

bears against the forward end of the wedge.

The cross-plank is a support for the forward runners, and is composed of a piece of lumber similar to the stock used in the backbone. It is 8 ft. long, 8 in. wide, and 2 in. thick. The runner guides at each end consist of two blocks of 2 by 4 15 in. long bolted to the under side of the cross-plank with carriage-bolts. (See Fig. 2 and side elevation.) Bore a hole through the



Study the illustrations, Figs. 1 to 6, carefully for the details of construction of the framework bearing the engine and of the method of attaching the runners

center of the blocks for the pivot bolt in the runners. Insert a strong eye-bolt in the rear edge of the cross-plank close to each pair of runner guides.

The two forward runners are made of oak 30 in. long, 4 in. wide, and 1½ in. thick. The forward end is shaped similarly to a sled runner, and the bottom is shod with half round strap-iron. Bore a hole, to match that in the guides, in the center and 1 in. from the top edge. Pivot them to the space between the guides with ⅝-in. bolts, locking the nuts.

The steering runner is of similar dimensions and construction, except the mounting. The hole is bored 2 in. below the top edge, and is pivoted between the legs of a U-shaped wrought-iron hanger. This can be made by any blacksmith. Use a ⅝-in. bolt for pivoting. Drill a 1-in. hole in the shoulder of the hanger, and insert a 1-in. steel bolt to act as the rudder-post. Square the top end of this bolt about 2 in. down to take the tiller. The rest of the assembly is shown in Fig. 3. Insert it through the hole in the backbone and take up on the adjustment until the rudder turns easily but not loosely. The spring shown tends to keep it at a tension and to some extent acts as a shock-absorber.

The tiller consists of a piece of oak 2 ft. long, 4 in. wide, and 1 in. thick, with a square hole in the center to fit over the squared end of the rudder-post. Tnis is held in place by a large cotter-pin inserted through a hole in the post. Provide two holes in the ends of the tiller for the steering-ropes.

The body is assembled by clamping the cross-plank to the front of the back-bone by means of four strap-bolts, as shown in Fig. 4. The plank is set under the backbone, the center of the plank coming 20 in. from the front of the forward cross-piece of backbone. Use washers and nuts under the plank, and take up on these occasionally so no undue play will occur. Place two wire stays with turn-buckles between the ends of cross-plank and the sides of backbone as shown. These should be tightened occasionally.

Place a dashboard, made of oak and braced as indicated, just forward of the front end of the platform. This is used to support a wind-shield of any desired style and as a support for the steering column.

Two bucket seats of conventional design can be placed upon the platform staggered as shown, so the driver will be slightly forward of the passenger. These can be tipped slightly back if desired.

Engine-Bed and Power Plant

The engine-bed is composed of the forward portions of the backbone timbers and the end cross-piece. The dimensions are shown in Fig. 5. This is the right size to take a Ford engine without alteration. The two side supports bolt to the frame 31 in. from the front, and the front support bolts to the front cross-piece together with the crank bearing.

Remove the engine from the chassis, and cut off the drip-pan just behind the forward support. First mount the radiator between the sides exactly as it was in the chassis (Fig. 1). Then set the engine in place on the bed. Strap the crank-bearing (Fig. 1) to the cross-piece in the exact center, and include the forward engine support with it. Then bolt down the side supports, using bolts to go through the timbers and bolt underneath. Next, set up the dash, 31 in. back from the inside face of radiator. Support this by two triangular sides of sheet iron (as shown in the side-elevation sketch) to hold it rigid as well as to protect the engine transmission. Secure the top of the radiator to the dash with the tie-rod.

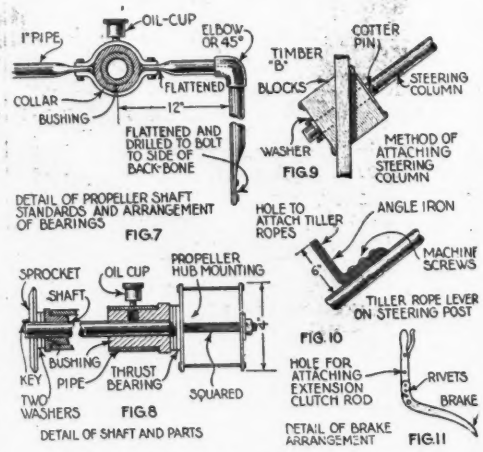
All other engine installations are made just as in the original chassis.

Remove the universal joint and alter it as shown in Fig. 6. This consists of cutting off the shaft-housing and shaft just below the drive-shaft bushing. About 2 in. of shaft should project from the housing. Place on a thrust bearing a suitable sprocket, and secure with a lock-nut. Before doing this, however, cut a hole in the center of timber *A* in line with the drive-shaft in the engine transmission, and then set the universal joint back in place. Bolt it to the timber through the holes in the housing shoulders formerly occupied by the rear radius rods. Take care that the sprocket runs perfectly vertical and at right angles to the engine-shaft.

The propeller-shaft runs in a frame mounted directly over the engine (Fig. 7). This is made of 1-in. iron piping, and can be either made square by joining the sections by elbows or can be made more upright by using 45° connections. This is optional. This frame supports a length of 1½-in. pipe running horizontally and directly over the engine. Inside each end of the pipe is forced a shouldered bushing, 1 in. inside diameter. A pair of metal collars fit around each end of the pipe and also hold the flattened ends of the standard ends between them, as shown. Bolt the collars and frame ends together. Insert an oil-cup in the top of each top collar and extend it down through the bushing. The length of this pipe and height of the standard will depend upon the length of the shaft and the length of the propeller.

The propeller mounting is shown in Fig. 8 and need not be described in detail. The end of the shaft supporting the propeller must be squared and have a shoulder back of the rear disk of the mounting. Between the rear disk and the bushing is a thrust bearing. The nut on the end of the shaft must be securely locked. Use six bolts to connect the disks. They must be long enough to pass through the hub of the propeller.

The shaft must be of a length to allow the propeller to clear the radiator



Details are given here of the propeller-shaft bearings, the method of attaching the steering column, the power transmission by sprocket-wheel, and the brake

by at least 3 in. and to allow the sprocket on the opposite end to come directly over the sprocket on the engine-shaft. The propeller-shaft is 1 in. in diameter.

When the shaft, bearings, and standard are all assembled, bolt the sides of the standard to the sides of the engine-bed, as shown, being careful to get the propeller-shaft in exact line. Also be sure that the shaft is high enough so that the propeller tips will clear any obstructions.

Use sprockets and chain heavy

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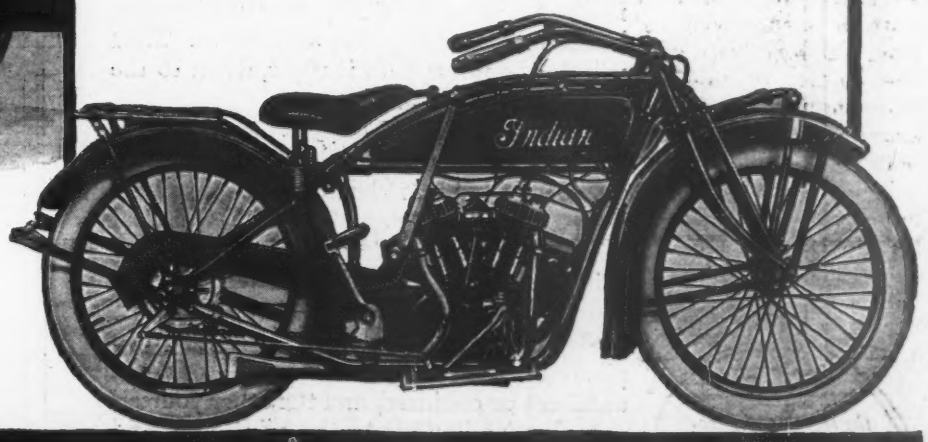

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It's a shock to finish the house or factory and find we've forgotten a point in fire protection that costs a thousand dollars to fix. There are pitfalls, discouragements and remorse for the average owner who builds alone. Enter the old adage, "Cobbler, stick to thy last."

At a small fraction of the cost of our own ill-starred experiment the best engineering brains in the country will work for us. They will do the job and do it right, down to the last electric light and switch.

Whether it be a home where artistry, building skill and liveability are to be fused into one; whether it be a problem involving a most specialized department in a technical industry—the architect and the engineer bring a seasoned and unbiased judgment to the task.

After all, how much better to set two minds at work on the problem—one the architect or engineer, and the other yourself—each contributing to the solution. And this is aside from the economy of it.

Published in the interest of Electrical Development by an Institution that will be helped by whatever helps the Industry.

Western Electric Company

No. 13 *Western Electric—an organization whose products and services apply alike to all fields where electricity is used—in the power plant, in the shop, on the farm and in the home.*

enough to bear the load and keep them well lubricated.

Use a propeller between five and six feet long, and choose sprockets geared to turn it about 1500 r.p.m. when the engine is turning over about 1000 r.p.m. Any further increase in the speed of the engine will tend to rack it. Furthermore, greater speed of the propeller is dangerous.

Mount the propeller on the shaft and test for alinement to make sure there is no side play or wabbling due to shaft looseness. This may be adjusted by tightening or loosening the hub bolts as required, tightening all when the propeller turns true.

Controls

Mount a gas-tank inside of the engine dash and connect it with the carburetor. The steering-wheel and post of the car can be used as shown. Run the post through a hole in the dash and through another in the timber *B*. Two diagonal blocks, made by sawing a short 2 by 3 across diagonally, and nailed to each side of the timber, give a bearing for the retaining washers as shown in Fig. 9. Run the steering-ropes (or wires) through the sides of backbone over pulleys and connect them to an upright on the steering column (Fig. 10). This will turn the craft to the left when the wheel is turned to the left, similarly to a ship's wheel.

Fig. 11 shows the brake. This is a supplementary piece of steel riveted or welded to a brake-lever mounted on the side of the backbone near the driver's seat. Connect this brake-lever by a small iron rod with the one operating the clutch of the engine. By removing the ratchet from the forward one, the action can be controlled by the rear one. When pulled back, it forces the brake into the ice and at the same time pulls out the clutch, running the engine free. This method is used in starting so the propeller will not revolve when the engine starts. When the driver steps aboard, he releases the lever easily, and the clutch engages, turning over the propeller and gradually pulling the craft under way. When he wishes to stop, he pulls upon the brake-lever, disengaging the clutch, and brings the craft to a halt by digging the brake into the ice.

Spark and throttle controls can be used as usual by extending the control rods to the wheel.

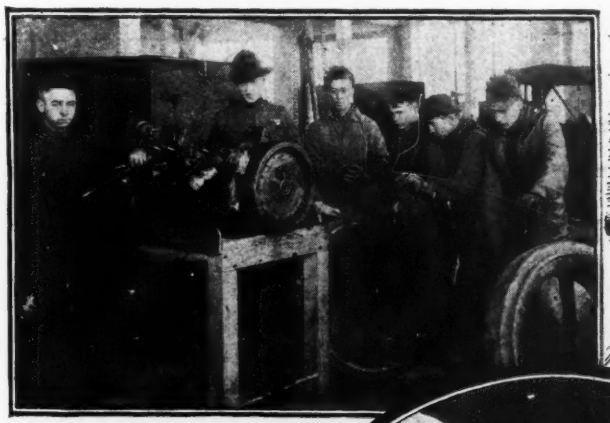
Searchlights can also be used if desired with a switch at the wheel.

When starting the engine, make sure that the brake is set so no accident may occur through the suddenly revolving propeller. Use the icemobile on a large expanse of ice where the most enjoyment can be had by long runs. Since it is capable, under good conditions, of attaining good speed, a small lake would not offer adequate opportunities.

Make turns slowly and use the full

THE US ARMY TEACHES TRADES

Army Automotive School



Army Motion-Picture Studio

Army Class in Radio

IS YOUR JOB as good as you want? Or does it take all your time to earn a living—with no chance to learn something better or see new places or faces?

In the army a man can learn to be a mechanic, a carpenter, a painter, a scientific farmer—a skilled man in almost any occupation.

While he's learning, he's earning a good living—and he gets out of the old rut and into new, broadening surroundings.

EARN, LEARN AND TRAVEL

It pays to put Underwear money into "Hanes"

—bigger value longer wear and greater comfort!

HANES ELASTIC KNIT UNDERWEAR

Hanes Guarantee

"We guarantee Hanes Underwear absolutely—every thread, stitch and button. We guarantee to return your money or give you a new garment if any seam breaks."

FOR years "Hanes" winter underwear for men has proven itself to be the *national underwear standard;* its sales exceed any elastic knit underwear! Its popularity extends from coast-to-coast!

"Hanes" wins on merit! It is not fancy underwear, but it has enduring quality in its Hanes-spun yarn, in its "Hanes" directed workmanship! And, its warmth, its service and its comfort cannot be exceeded at the price!

Your confidence in every "Hanes" garment, in every "Hanes" thread and stitch can never be misplaced! *"Hanes" guarantee proves that!*

"HANES" underwear is made in heavy and medium weight union suits and heavy weight shirts and drawers. The medium weight union suit, new this year and illustrated in this advertisement, is of exceptional interest to every man who works indoors. It is made of full combed yarn, is silk trimmed and carries the yellow Hanes label.

"Hanes" Union Suits have the tailored collarette that fits closely and will not gap; closed crotch stays closed; an extra gusset gives extra thigh comfort; buttonholes will not stretch, and last the life of the garment; pearl buttons sewed on to stay; elastic knit cuffs and ankles hold their shape; flat unbreakable seams. Shirts have the snug fitting "Hanes" elastic knit collarette, sateen vent and elastic knit wrists. Drawers are cut roomy and have the durable "Hanes" 3-button sateen waist band.

"Hanes" for boys

Put the boys into "Hanes" Union Suits—the biggest value in quality, wear, warmth and comfort for boys ever sold at the price. These boys' suits duplicate the men's Union Suits in important features with added fleeciness. They stand the stiffest wear and the hardest wash.

Made in sizes 20 to 34, covering ages from 2 to 16 years. Two to four year old sizes have drop seat.

Inspect these remarkable "Hanes" garments at your dealer's—at once. If he cannot supply you, write us.

P. H. HANES KNITTING CO., Winston-Salem, N. C

New York Office: 366 Broadway

Warning to the trade: Any garment offered as "Hanes" is a substitute unless it bears the "Hanes" label.

Next Summer—You'll want to wear Hanes Nainsook Union Suits!

power of the engine on straightaways only.

On extremely cold days do not use the cooling fan, as the draft from the propeller will be sufficient to cool the engine; a cover may even be necessary.

Speed depends upon the condition, r.p.m. of the engine, and size and pitch of the propeller; but thirty-five or forty miles an hour should not be hard to obtain under even adverse conditions.

How to Clean a Clogged Fountain-Pen

A SELF-FILLING fountain-pen is often filled with ink that is not absolutely free from sediment. An occasional rinsing of the reservoir will aid in preventing the clogging of the

Use a fine needle for cleaning the feed duct of your favorite fountain-pen

feed duct to the pen, but the small duct into the barrel of the pen very often becomes clogged.

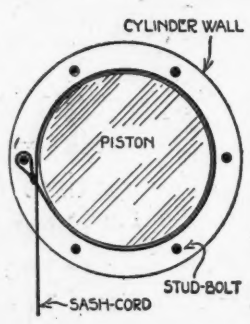
In case of a clogged feed, secure a small, fine needle, and push this under the gold pen and up along the feed duct, into the ink reservoir. Then rinse out thoroughly with water and you will find that your pen will again work properly.—G. W. GREENE.

Compressing Piston-Rings to Enter a Cylinder

THE illustration shows a simple and very satisfactory way of compressing piston-rings so that they will enter an engine cylinder easily.

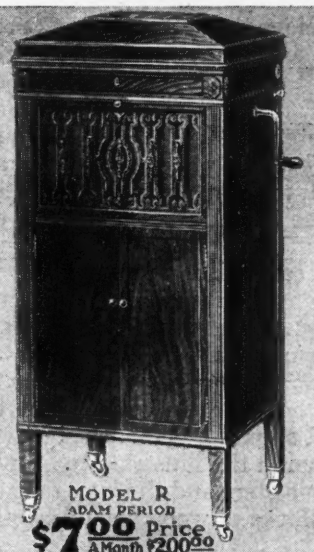
The piston is slipped into the cylinder as far as the first ring.

Some sash-cord is fastened to one of the cylinder head studs, wrapped around the piston-ring, and pulled up tight. The ring is thereby compressed evenly all around and will enter the cylinder quickly.—VAN ALLEN LYMAN.



Piston-rings are hard to insert into a cylinder. Here is one way of doing it

No Money Down



MODEL R
ADAM PERIOD
$7.00 Price
A Month $2.00
Mahogany, Walnut or Fumed Oak
Gold Plated Metal Parts

MODEL H
LOUIS XVI PERIOD
$5.00 Price
A Month $1.35
Mahogany or Walnut

MODEL J.
LOUIS XV PERIOD
$6.00 Price
A Month $1.65
Mahogany, Walnut or Fumed Oak
Gold Plated Metal Parts

Let Us Send You a SILVERTONE Phonograph for Two Weeks' Trial in Your Home Without Expense to You

WE WANT you to try one of these beautiful SILVERTONE Phonographs in your own home for two weeks without a cent of expense and without obligating you to buy if you are not fully satisfied with the instrument.

Select any SILVERTONE Phonograph shown on this page, fill in the order blank and mail it to Sears, Roebuck and Co. today. We ship SILVERTONE Phonographs on two weeks' trial. You take absolutely no risk, nor do you obligate yourself in any way by taking a SILVERTONE on trial. All we ask you to do is to give the phonograph a thorough test. Examine its mechanical features, cabinet work, workmanship and finish. Try it with any disc record you desire, and note its beauty of tone and fidelity of reproduction. Give it every test necessary to prove the truth of our claims for it. And then compare the price of the SILVERTONE with that of any other phonograph of the same size, beauty and musical excellence.

If, at the end of two weeks' trial, you are not fully satisfied with the SILVERTONE, if you do not believe that it is in every way the equal of any phonograph on the market selling at prices from 25 to 50 per cent higher than the SILVERTONE, simply notify us and we will take away the phonograph at our own expense and will refund any transportation and cartage charges you have paid. The two weeks' test will not have cost you one cent nor placed you under any obligation.

Play as You Pay—Very Easy Terms

If, after two weeks' trial, you are fully satisfied with the SILVERTONE and desire to keep it, simply send us the first monthly payment and then the same amount each month until the total is paid. The amount of the monthly payment on each instrument is shown under the illustrations.

Compare our terms with those offered on any other phonograph of the same high quality. The small monthly payment required on even the highest priced models makes it easy for you to own a really fine instrument without incurring a heavy financial burden.

This Liberal Selling Plan Is the Best Guarantee of SILVERTONE Quality

We know that the SILVERTONE Phonograph is right in every respect—mechanically, musically and in design and finish. That is why we can offer them on this liberal no money down trial basis. We know that when you get a SILVERTONE Phonograph in your home for two weeks' trial you will be convinced of its high quality and will agree with us that it is the best phonograph on the market at anywhere near the same price. We have sold over 330,000 SILVERTONE phonographs, and the unanimous praise of their owners is the most convincing proof of SILVERTONE quality.

Plays All Disc Records

The SILVERTONE convertible tone arm is so constructed that it permits the playing of any make of disc record, either vertical or lateral cut. It is almost as easy to adjust the reproducer for different types of records as it is to change needles.

Size of Cabinets

The Model H Cabinet is 45¼ inches high. The others are illustrated in proportion.

MODEL N
LOUIS XV PERIOD
$7.50 Price
A Month $2.25
Mahogany, Walnut or Fumed Oak
Gold Plated Metal Parts

MODEL S
QUEEN ANNE PERIOD CONSOLE
$7.50 Price
A Month $2.15
Mahogany or Walnut
Gold Plated Metal Parts

Silvertone

MAIL YOUR ORDER TO THE NEAREST ONE OF OUR FOUR STORES.

SEARS, ROEBUCK AND CO. **91P90** Date _____ 192__

You may ship me the SILVERTONE Phonograph which I have marked with an (X), without any obligation on my part to buy unless I am perfectly satisfied.

If, after two weeks' trial, I decide to keep and use the instrument, I will send you the first payment for the phonograph and pay the same amount each month until paid in full; then the SILVERTONE becomes my property.

Should I decide, after two weeks' trial, that the SILVERTONE is not satisfactory, I will notify you, and you are to give me instructions so that I may send it back at your expense. You are also to return to me any transportation and cartage charges I have paid.

I have always been faithful in paying my obligations and am making this statement for the purpose of inducing you to grant me these terms, and I give you my pledge that you may feel safe in trusting me to pay as agreed.

Sign Here _____ R.F.D. No. _____ Box No. _____ Street and No. _____

(Sign your name here plainly and carefully. If under age, some member of your family who is of age and responsible should sign this order with you.)

Postoffice _____ County _____ State _____

Shipping Point _____ County _____ State _____

I have been located in this town since _____ If less than 5 years, give former address _____

My business, occupation or profession is _____ Do you wish shipment made by express or freight? _____

REFERENCES—(Please give names of TWO references.)

Name	Address	Business or Occupation

We ship Silvertone Phonographs to all parts of the U. S. We do not accept orders from foreign countries.

Model H.
☐ Mahogany.
☐ Walnut.
Price, $135.00
Payment, $5.00 a month.

Model J.
☐ Mahogany.
☐ Walnut.
☐ Fumed Oak.
Price, $165.00
Payment, $6.00 a month.

Model R.
☐ Mahogany.
☐ Walnut.
☐ Fumed Oak.
Price, $200.00
Payment, $7.00 a month.

Model S.
☐ Mahogany.
☐ Walnut.
Price, $215.00
Payment, $7.50 a month.

Model N.
☐ Mahogany.
☐ Walnut.
☐ Fumed Oak.
Price, $225.00
Payment, $7.50 a month.

Sears, Roebuck and Co.
Chicago · Philadelphia · Seattle · Dallas

For CHRISTMAS!

The day's duties and the day's doings take on a new significance following a joy-spin to work on a Columbia in the fresh air and sunshine of a dewy morning.

The open road and the woods never are so inviting, so exhilarating, on Sundays or holidays, as when a Columbia pilots you.

You never realize how stiff railroad and trolley fares are until you buy a Columbia and put those saved sums on its purchase price.

Get that 1921 Columbia *now*. See the various models at your dealer's *today*. Write for a 1921 Columbia Catalog. Ride a bicycle—a *Columbia*. *Live, save, be strong, healthy* —do *your* share toward giving that greater efficiency and promoting that greater production the nation so truly needs. There is a model and a price for every individual preference—for you, for the wife, for the kiddies.

Westfied Manufacturing Co.
45 Lozier Ave., Westfield, Mass.

Ride a Bicycle

CUT YOUR OWN HAIR—EASIER THAN SHAVING

PATENTED OCT. 8, 1918 PRICE TO INTRODUCE ONLY **$1.00**

You do not need any experience or practice to use the **DUPLEX AUTOMATIC HAIR CUTTER.** It comes to you ready for instant use, and five minutes after you receive it you can have your hair cut better than it was ever cut before.

The **DUPLEX** will cut as closely or trim as long as you wish it to. No clippers or scissors are needed with the **DUPLEX;** it finishes the work completely. It cuts the front hair long and the back hair short. Trims around the Ears, etc.

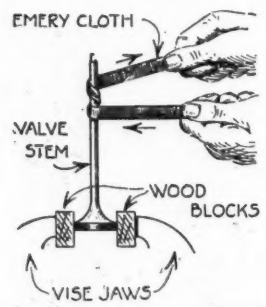
Inside of a very short time you will have to pay $2.00 for the **DUPLEX.** The price today is $2.00, but while our present stock lasts we will accept this advertisement the same as $1.00 Cash. Cut it out and send it with ONLY $1.00 and we will send you the **DUPLEX AUTOMATIC HAIR CUTTER** ready for instant use, postage paid, to any address. SEND TODAY.

AGENTS WANTED. DUPLEX MFG. CO., Dept. 18, Detroit, Mich.

How to Clean Valve-Stems on the Automobile

WHEN the time has come to remove the accumulation of carbon from the cylinders of the automobile engine and to grind in the valves, particular attention should be paid to the valve-stems. These, too, should be carefully freed from carbon and other foreign matter that would interfere with the free movement of the valve-stems in the guides. Such incrustations mean loss of power to the engine, frequent missing, and difficulty in starting. To insure good valve action the stems must be kept clean and bright.

The head of the valve-stem to be cleaned should be clamped in the vise as shown in the illustration. Between the valve-stem and the jaws of the vise small blocks of wood should be placed



Hold the valve-head between blocks of wood in the vise and clean the stem with emery-cloth

to insure a firm grip on the stem and to prevent injury to the head of the stem. Then a narrow strip of fine emery-cloth should be wound around the stem, as shown in the illustration, and seesawed by alternately pulling the two ends, moving the strip up and down at the same time. Usually a few strokes will suffice to clean the stem and make it bright. The emery-cloth should not be drawn too tightly.

After the stem is cleaned, the face of the valve should be wiped carefully with a cloth dipped in kerosene, to remove every trace of dirt. Then it should be lubricated and replaced in the cylinder.

Mixing Acid and Water for the Battery

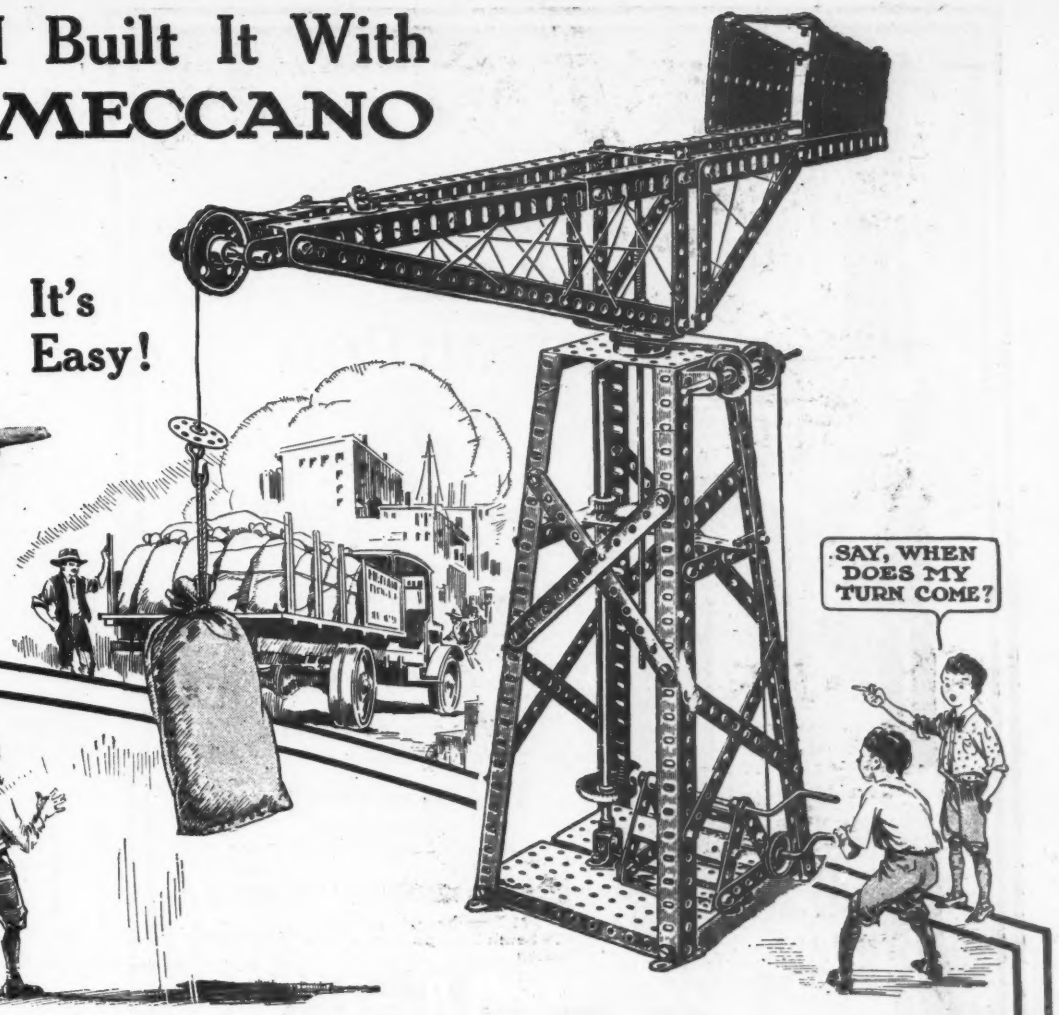
IF the storage battery requires a new solution, it should be mixed outside and then poured in the battery tank. Chemically pure sulphuric acid has a gravity around 1.84, and to obtain the required gravity, 1.300, before putting it into the cells, it has to be mixed with water.

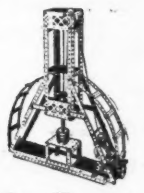
Measure out two parts of the acid to five of water, and mix them thoroughly in an earthenware or glass container, which is proof against the action of strong acid. Pour the acid into the water in a small stream (not the water into the acid) and allow the solution to cool before pouring it into the battery.

I Built It With MECCANO

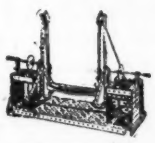
Yours for a "Merrier" **XMAS!**

It's Easy!



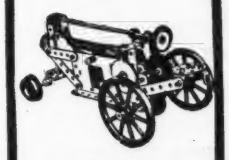


Drop Hammer

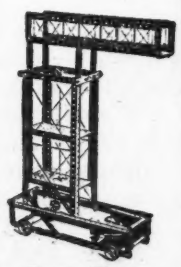


Boat Davits

Beam Engine



Tractor



Tower Wagon

$1250 GIVEN IN PRIZES FOR BUILDING MODELS

You Can Build Hundreds of Models *with* MECCANO

Toy Engineering for Boys

WITH Meccano you can build hundreds of fascinating models in shining steel and brass—and, with your dandy Meccano Electric Motor, make them run like real machinery. No study. Follow the simple directions and, before you realize it, you have a wonderful Crane like the one above. Turn the crank handle and the model will work; or run it with your electric motor. Manual of Instructions with each outfit.

And, Oh, what a thrill of joy it is to *invent* new models—to see your own ideas take form in steel and brass!. By all means, tell Dad you want Meccano for Christmas.

See These MECCANO Outfits AT YOUR DEALER'S

No. 0	$1.50
No. 1	3.00
No. 1X	5.50
No. 2	6.00
No. 2X	8.50
No. 3	9.00
No. 3X	11.50

And up to $40.00

Motors

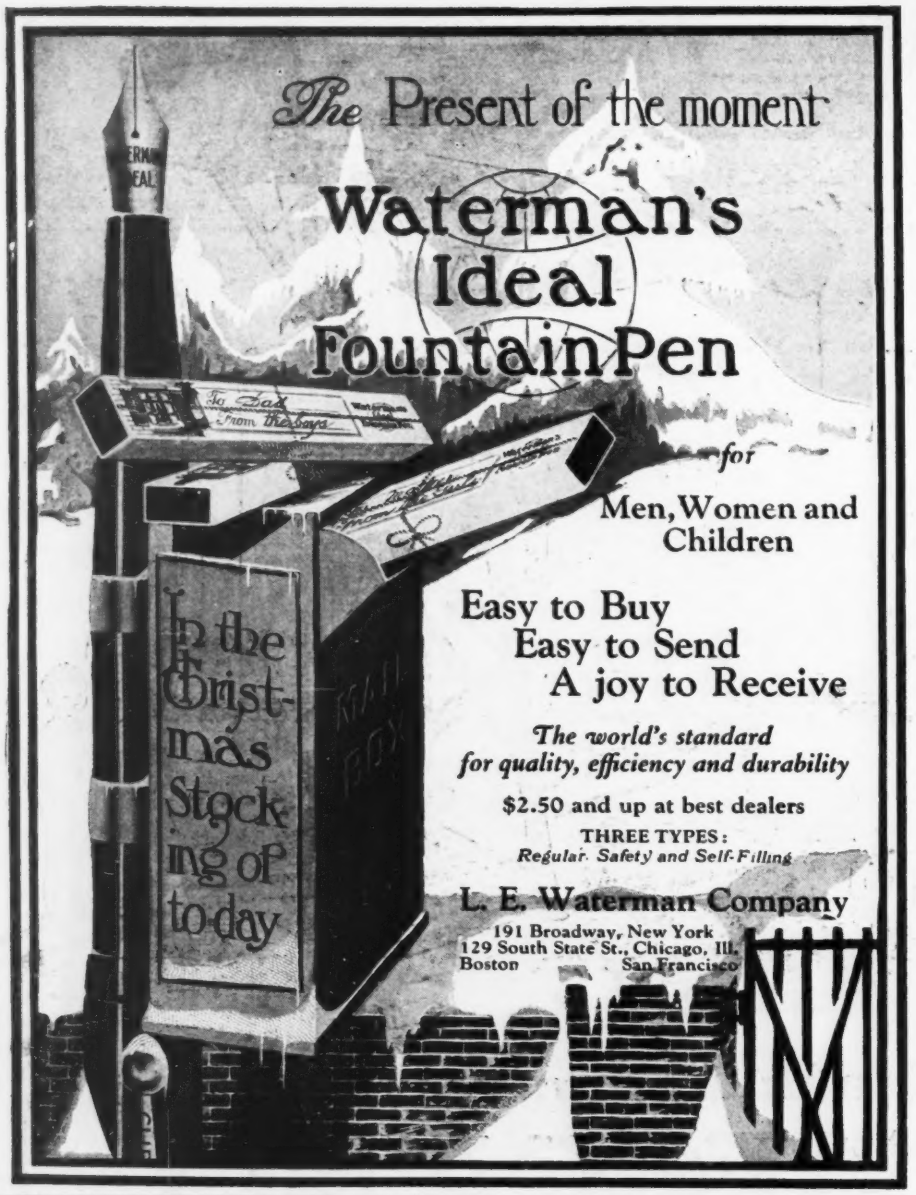
Electric, Reversing	$4.50
Electric, Non-Reversing	3.00
Clockwork Motor	3.00
Transformer	3.25

Outfits and motors sent prepaid on receipt of price if not at your dealer's. X outfits and motors slightly higher in Canada.

Send for FREE XMAS BOOK

Contains the inventor's entertaining story of Meccano. Illustrated with numerous interesting pictures of models and boys building them. The kind of a book a boy likes to get wrapped up in. Just the thing to help you and Dad to pick out your Christmas outfit. Merely write us your name and address and it will be sent you in the next mail. Get *yours* good and early.

MECCANO COMPANY, Inc., *Division K*, 71 West 23d St., New York, N. Y.


The Present of the moment
Waterman's Ideal Fountain Pen
for
Men, Women and Children
Easy to Buy
Easy to Send
A joy to Receive
The world's standard for quality, efficiency and durability
$2.50 and up at best dealers
THREE TYPES:
Regular Safety and Self-Filling
L. E. Waterman Company
191 Broadway, New York
129 South State St., Chicago, Ill.
Boston San Francisco
In the Christmas Stocking of to-day

CONSTRUCTION OF SMALL ALTERNATING CURRENT MOTORS. By A. E. WATSON. This book contains complete instructions for building small alternating current motors in several sizes. The designs will be found in harmony with those of the very best manufacturers and they can be worked out by the amateur for making useful instruments. Fully illustrated. Price Postpaid, $1.25.
POPULAR SCIENCE MONTHLY
225 West 39th Street New York

CONSTRUCTION OF INDUCTION COILS AND TRANSFORMERS, by Thomas Stanley Curtis. Full of practical notes and instruction. Tells you both the why and the how. Little is left to guess work. Open and closed core transformers are both taken up. For a practical instruction book on the whole subject this one is hard to beat for the price. Price, postpaid, 25 cents
POPULAR SCIENCE MONTHLY
225 West 39th Street New York

Build Your Own PHONOGRAPH
IT'S EASY WITH OUR HELP

Get our FREE Blue Print Offer
DEALERS WANTED FOR OUR Ready Built Phonographs

A few hours' interesting work saves many dollars—gives you a fine machine exactly suited to your ideals—better than many machines costing much more. Plays any record.

We furnish complete, simple plans and diagrams—anyone can understand them—motors, tone arms, case material, everything required, and full instructions. F. C. Strong, Canada says: "Please send me one of your circulars, 'How to Build Your Own Phonograph,' as I would like to make one. Mr. Gallie has built one and if he hadn't told me that he had made it himself I would have taken it for a $150 model." Listen to this from Charles F. Mancke, Wash.: "Received the two outfits, and am well pleased. I built one machine for myself and took an order for one for $175. I now have mine done, and it has a wonderful tone. I would not take $200 for it."
We are the originators of the home building idea. Our customers always succeed because our plans and system are easy and clear. No special skill necessary.

SAVE OVER HALF

Make Big Money Building Phonographs
Ask for Our Sure-Fire Plan and Free Blue Print Offer

You can make hundreds of dollars easily. Ask us. We tell you how and help you. We have started many others. We can start you. Pleasant, easy work. N. J. Adams, Michigan, says: "Just sold my phonograph which I built from your plans and parts at nearly $100 profit. Only took about a week working evenings to build it. Those who have heard it say that it is better than phonographs they have seen and heard at $200."

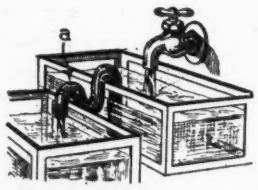
Become a Home Dealer—Wonderful Plan

Our dealers' proposition on our ready built Phonograph will appeal to you. It's the best thing yet. No canvassing—no work—no capital needed. It works every time. We give you full particulars and show you how to make sure, easy money. Remember, we are the old reliable house-originators of the home building and home dealers idea. Write today. Get our proposition. Have a fine phonograph at half price and make money besides.

Choraleon Phonograph Co., 1220 Second Street ELKHART, IND.

Leveling Liquids with an Automatic Siphon

IT is often very convenient to have an automatic siphon that will remove liquids to a certain level and maintain that level although more liquids should subsequently be added. Such a siphon consists of a lead tube about 10 in. long bent as shown in the illustration. The loop at *A* is at the level at which the liquid is to be kept. A small air hole is also made at the top of this loop. After the siphon has been started it will continue to function until the liquid falls to its normal level. Should the liquid rise again it will automatically drain off the surplus liquid.—ERNEST BADE.



This automatic siphon keeps liquids at a constant level

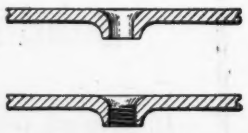
An Experiment for the Flash-Light Photographer

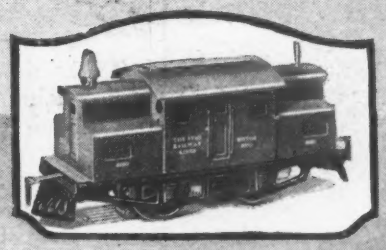
THIS experiment requires practically no apparatus and gives immediate and startling results. It is simply short-circuiting the 110-volt house current with a piece of No. 36 wire. This does not blow a fuse, because the current blows the smallest wire in the entire circuit.

A practical use for this experiment is to set off flash-light cartridges. These usually are supplied with a slow-burning fuse; but in some cases it is difficult to prevent the subjects from moving while the fuse is burning noisily. A very quick way is to drop a short length of the No. 36 wire in one of the cartridges. When all is in readiness, the photographer simply snaps on the house current, and the picture is taken.—PHILIP A. WALL.

Setting Machine Screws in Thin Metal

THERE are many cases where it is desirable to tap a machine screw into thin sheet metal with some assurance that the screw will hold, though the metal is too thin to take sufficient thread to be of any practical use. The desired end is easily accomplished. Punch the hole for the screw with a punch that will force the metal aside, forming a sort of short cylinder, which will be long enough to take a few threads and hold the screw reasonably well. The best kind of a punch to use is one with a sharp point, a long bevel, and a shank the diameter of the tapping hole.


By punching a tapping hole in sheet metal, surface is obtained to take a good thread



The playthings of today make the men of tomorrow

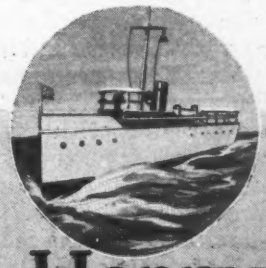
Ives mechanical and electrical trains, and Ives steel boats with their long running motors and screw propellers, will teach you all about the big business of transportation.

You lay the tracks and install switches, signals, stations and tunnels. The trains are just like the real ones—with long, powerful engines or electric locomotives that whizz over the tracks and beautifully painted passenger and freight cars.

Ives boats include ocean liners, tugs, yachts, destroyers, submarines and U. S. Merchant Marine steamships. Write for our finely illustrated book, "Ships and Shipping," and a big booklet on trains, full of information and finely colored plates. Both sent for 10c in stamps, to pay postage and packing.

The Ives Manufacturing Corporation

191 Holland Avenue — Bridgeport, Conn.



Ives Toys

Make Happy Boys

What do you know about bicycles, anyway?

WE'VE shown the Kokomo Bike Book to hundreds of "regular fellows"—riders of many years' standing — and nearly all of them have found some new and really valuable facts in "The Bike Book."

They've been glad to learn how to pedal their bikes more easily, ways to properly clean them, and what constitutes good bicycle tires.

We got the book out, first to be helpful to our rider friends, and second to remind them of the worth and goodness of Kokomo Bicycle Tires.

Until the supply runs out, we'll be glad to send a copy to anyone who asks for it.

KOKOMO RUBBER COMPANY
40 S. Main Street
KOKOMO, INDIANA

"Contributors to Cycle Trades of American Advertising Campaign."

LONG-LIFE
Kokomo
BICYCLE TIRES

Things I Made that Reduced the H. C. of L.

How some readers of the Popular Science Monthly sought to solve the vexing problem

IT is highly significant that the overwhelming majority of the answers received from readers of the Popular Science Monthly in the prize contest "How to Beat the H. C. of L.," launched early in the year described mechanical appliances for heating the air in rooms, shops, or houses, or for providing hot water for domestic purposes.

So great was the numerical preponderance of answers aimed at the reduction of the cost of fuel that the announcement of the decision of the contest was reserved for the December number, as most appropriate for the descriptions of the various fuel-saving devices.

The first prize, consisting of $50, was awarded to E. S. Cook, of Alpena, Michigan, for his meritorious method of providing a hot-water supply in his kitchen at a trifling cost.

For his method of providing hot water in the kitchen by simple means, E. S. Cook, of Alpena, Michigan, was awarded the first prize of $50

Mr. Cook first of all placed a coil of copper tubing, taken from an old water-heater, in the fire-box of his heating furnace. One end of the coil he connected with a pipe leading to a homemade water-tank placed near the kitchen ceiling; the other end, by means of another pipe, with the hot-water faucet of the kitchen sink.

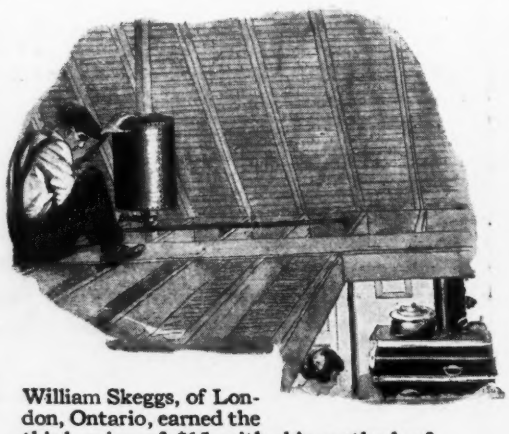
R. J. Hammond, of Huntington, Long Island, earned the second prize of $25 by describing how he reduced the high cost of shoes. He bought from a junk dealer an old automobile cord tire that was past mending, split it, and made from this almost indestructible material soles for his shoes, old as well as new. These soles were cemented and tacked to the leather soles.

Extending the life of his shoes by providing them with soles cut from an old cord tire, won for R. J. Hammond, of Huntington, Long Island, $25

With his description of the method employed by him for heating two rooms with hot water from the kitchen range, William Skeggs, of London, Ontario, Canada, earned the third prize of $15.

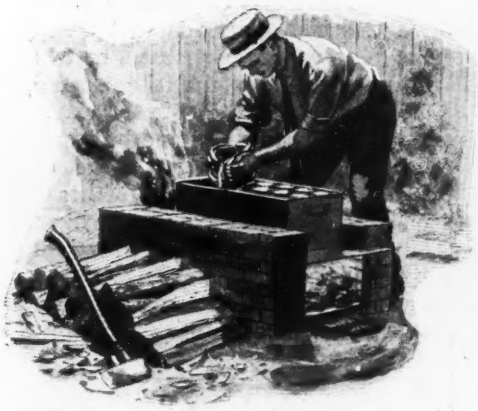
He laid a 1-in. feed-pipe from the water-front of his range to an expansion tank holding about two gallons in the attic. From that pipe he conducted the hot water or steam by means of T connections to two old radiators in adjoining rooms, and from the bottom of the radiators the water was led back to the range in a return pipe provided with a drain-cock.

Another answer, although it was not awarded a prize, is so meritorious that it deserves honorable mention. P. C. Henry, of Conover, North Carolina,



William Skeggs, of London, Ontario, earned the third prize of $15 with his method of heating two rooms by hot water from the kitchen range

describes how he built a hearth in his back yard from a pile of old bricks left over after the remodeling of a building. On this hearth, which did not even have a chimney, he heated the water in a sterilizing tank large enough to



Using a pile of old bricks for building an open hearth for sterilizing fruit and vegetable preserves merited honorable mention for P. C. Henry, Conover, N.C.

hold thirty cans of one-quart size. This sterilizing hearth he used with excellent success for preserving fruits and vegetables grown in his garden during the season.

Ten other answers selected as particularly meritorious from among the numerous replies received from contestants will be found on pages 72 and 73 of this issue, entitled "Fighting the H. C. of L. at the Cellar Furnace."

Here Is the Standard Scale of Tire Inflation

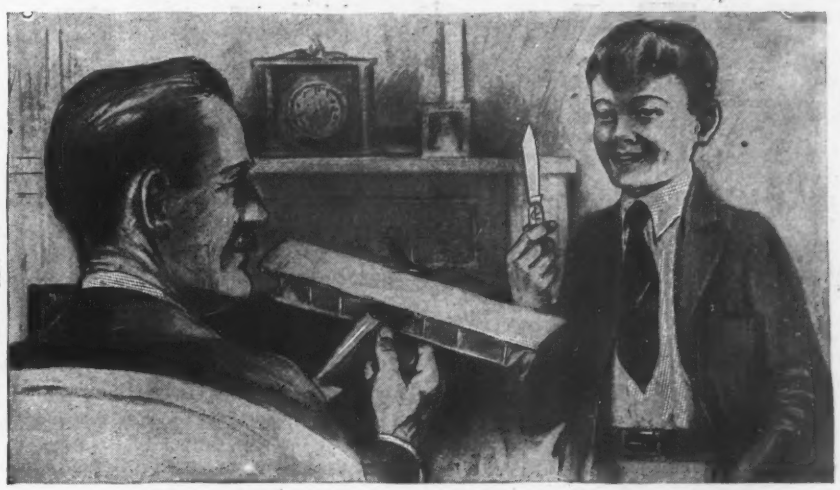
THERE is no use worrying about the small discrepancies in the inflation pressure tables of the different tire manufacturers. They are all near enough for all practical purposes.

Some of the manufacturers will tell you to put 60 pounds in a 30-by-3½-inch tire, whereas others will vary this to 55 or even 50 pounds in some instances. There is also a difference between the proper pressure for fabric and cord tires, the latter requiring a lower pressure than the former.

Therefore the standard scale of inflation pressures and loads as adopted by the Tire and Rim Division of the Society of Automotive Engineers is a most convenient bit of data to keep, as it gives the recommended pressure for any size of cord or fabric tires, and saves you the trouble of referring to as many different charts as you have different makes of tires on your car.

Here is the scale:

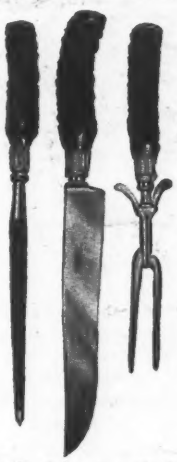
	Fabric Tires		Cord Tires	
Tire Size	Maximum Load to a Tire	Corresponding Air-Pressure	Maximum Load to a Tire	Corresponding Air-Pressure
3....	375	45	400	40
3½..	570	55	600	50
4....	815	65	850	60
4½..	1100	75	1200	70
5....	1500	85	1700	80



Trained Hands Serve Trained Minds

Don't Let Your Boy Grow Up All Thumbs!

RUSSELL
GREEN RIVER WORKS
CARVING SETS
are Ideal for the
XMAS GIFT



Knife of finest steel—in 6", 8" and 9" sizes, and is tempered to hold the edge.
The three pieces have beautiful stag handles, with sterling silver ferrules.
Ask your dealer for No. A-7541-E Carving Set.

No defect is so obvious as the untrained hand. You know a lot of men right among your friends and acquaintances who lack that knack of doing things requiring the slightest manual skill—they are clumsy—all thumbs—and it is all a matter of early training of the fingers.

Give your boy a RUSSELL

BARLOW KNIFE *and* **WHITTLER'S KIT**

It will afford him more real fun than anything else you can think of and teach him that knack of doing things which you admire so much in the "handy man."

YOUR BOY WANTS A KNIFE

Here's your chance to give him one and direct its use along lines which will be of real benefit to him in after life.

To stimulate interest in the Art of Whittling, the JOHN RUSSELL CUTLERY CO. will award

$250.00 IN CASH PRIZES

for the fifteen best examples of whittling done by boys with an ordinary pocket knife. There will be gold, silver and bronze medal awards, too. **This contest is open to every boy in the land!**

Ask your dealer about this Big Whittling Contest, and the Whittlers' Club—your boy will want to join both!

Price Complete $1.00

Each Kit Contains:
One Russell Barlow Knife
Soft Pine Whittling Sticks
Whetstone
Whittlers' Manual
Membership in the Russell Whittlers' Club and a Whittlers' Club Button—to prove it to the boys.

JOHN RUSSELL CUTLERY CO.
Green River Works
TURNERS FALLS, MASS., U. S. A.

IVER JOHNSON
SAFETY AUTOMATIC REVOLVER

"See, it can't go off accidentally"

"The only way to discharge an Iver Johnson is to pull the trigger (1) all the way back. This action raises the lifter (2) which forces the hammer (3) to cocking position. When lifter is at its highest point, the hammer covers the firing pin (4) and at this position the hammer is released, striking the lifter, which in turn strikes the firing pin."

No impact can force the hammer against the firing pin. Thus the world-famous slogan "Hammer the Hammer." And that is why women are not timid about having an Iver Johnson in the home.

Drawn tempered piano-wire springs keep the Iver Johnson permanently alive and alert. And the perfect rifled barrel speeds the bullet straight as a streak of light.

Choice of three grips: Regular, Perfect Rubber, Western Walnut.

IVER JOHNSON'S ARMS & CYCLE WORKS
343 River St., Fitchburg, Mass.
99 Chambers St., N. Y. 717 Market St., San Francisco

If your dealer hasn't in stock the particular model you want, send us his name and address. We will supply you through him.

Three Booklets—One or All Free on Request

"A"—Firearms; "B"—Bicycles; "C"—Motorcycles

Iver Johnson Single and Double Barrel Shotguns combine accuracy and dependability.

Iver Johnson Bicycles are world-famed for easy riding, strength, and durability. Models and prices to suit everyone.

YOU Can Do YOUR Own SOLDERING and All Metal Repairing With

25c PER TUBE
TORCH $1.25

A PASTE THAT TURNS INTO METAL WHEN HEATED

A match will do it. Requires no acid or soldering iron. Joins or repairs wires, metals or metalware. Sold by hardware and electrical stores or sent by us postpaid.

SOLDERALL CO., Dept. A,
129 SUSSEX AVE., NEWARK, N. J.
COMBINATION SET Tube and Torch Complete $1.50
Dealers Send for Quantity Prices
Look for Trade Mark "SOLDERALL." Beware of imitations with similar names

USED BY U. S. AND ALLIED GOVERNMENTS IN WAR

Learn How to Write Short Stories There is a big demand for short stories, photoplays and feature articles. You can learn how to write at home in spare time. **Jack London said so.** He and other great writers have endorsed our home study course. The course is fascinating and takes only a few of your spare hours.

Write for Free Book and details of our Limited Introductory offer. No obligation.

HOOSIER INSTITUTE, S. S. Dept. 1789 Ft. Wayne, Indiana

Factory to Rider Saves $15 to $25 on the model you select from **44 Styles**, colors and sizes of **Ranger** bicycles. Delivered free on approval direct from the Makers for **30 Days Free Trial.** We pay return charges if not satisfactory in every way.

12 Months to Pay Possession and use at once on our liberal year to pay plan. Any boy or girl can save the small monthly payments.

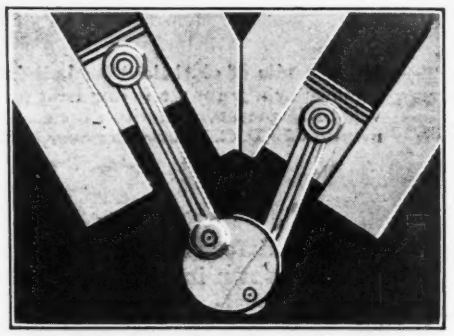
Tires wheels, chains, parts and equipment at half usual prices.

BIG RANGER CATALOG FREE, with marvelous new prices, 30 day trial offer and terms.

Mead Cycle Company Dept. G-109 Chicago Special Rider Agent plan to earn money.

To Make Cardboard Models of Engines

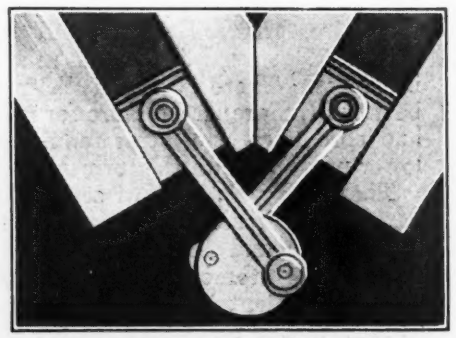
MOST designers of machinery find that to lay out the movement of the device is to invite a good deal of work with a considerable loss of time. This is true of all classes of designing, whether the device is just ordinarily complex or very intricate, or whether it is a monster engine to be used on an ocean greyhound, or merely a small model of such an engine. In order to determine the action of the engine through all the cycles of its complicated movements, a drawing must be made of each and every phase. Even though a finished drawing is not required, these drawings must be laid out in the same plane. After a number



Cardboard models like this clearly illustrate the movements of the engine pistons

of layouts have been made, one on top of the other, the result is one of confusion rather than of simplicity and the complete cycle of action is difficult to follow.

To make a finished model takes time and costs too much, especially when the design that is being worked out is a new idea and may or may not be practical. In that event it surely would not be desirable to go to the expense of having a finished model constructed. So why not make a



This shows the pistons of the V-type engine pictured above in a different position

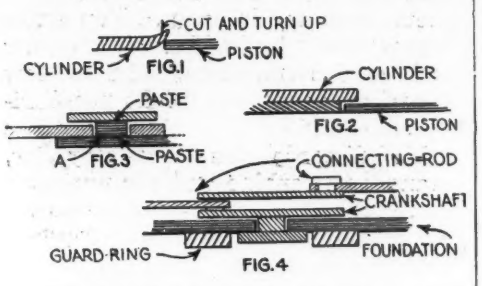
model of paper? It will answer the purpose and will tell the story quicker than any other way.

A model made of cardboard is shown in the accompanying illustrations. The model in this instance is that of a V-type automobile engine. No attempt is made at showing contour, the idea in mind being merely to illustrate the movements of the different parts. In making this model,

thin but stiff bristol board was used. A piece of heavy cardboard served as a foundation on which to build the rest of the model. The cylinders were made by cutting some of the cardboard away at an angle and bending up slightly. The sketch (Fig. 1) illustrates this. The cylinders can also be made by pasting two thicknesses of cardboard together, leaving about 1/16-in. overlap as shown in Fig. 2.

The pistons, which were of a single thickness of cardboard, could easily slide back and forth between the cylinder walls. The bearings for the connecting-rods were made as shown in Fig. 3. The piece *A*, which really is a true bearing, was slightly thicker than the connecting-rod, which permitted sufficient play for the rod.

The crankshaft was made of two disks, one connecting-rod being fitted to the top disk and the second connecting-rod being fitted between the



The diagrams shown here illustrate in detail the exact manner in which the various parts of the engine model are cut out of bristol board and put together

two disks as shown in Fig. 4. The crankshaft assembled was fastened by the same method as the connecting-rods. A circular ring guard piece was pasted to the back of the foundation so that when the crankshaft was turned there was no binding of parts. To operate, a stylo was inserted in a hole in the top connecting-rod and the crankshaft was then revolved. Every degree of revolution of the crankshaft could then be studied along with the action of the various other parts.—FRANK HARTH.

Watch Your Storage Battery in Cold Weather

MOTORISTS who use their cars all winter should be careful to see that their batteries are kept properly charged. A battery that is allowed to deteriorate or become even partially discharged is far more likely to freeze than one that is kept in good condition, as may be readily realized by comparing the following freezing-points:

Specific Gravity	Battery Condition	Freezing-Point
1.280	Full	70° below zero
1.260	¼ discharged	60° below zero
1.210	½ discharged	20° below zero
1.160	¾ discharged	zero
1.120	Empty	20° above zero

Joy in Shaving lies in Perfect Confidence -in yourself, -in your razor-

And that is all there is to the simple, pleasant, gentle-*manly* art of shaving.

Thirteen years of practical demonstration in the hands of more than two million confident users, furnishes that full confidence I have felt necessary for the right advertising of the

Enders Razor

Simplicity is its charm—cutting the beard quickly and easily, without scraping the skin, is its peculiar merit. Ease of adjustment, perfect cleanliness, lightness, firmness, beauty—and the $1.00 it costs—are contributing elements to your joy in shaving.

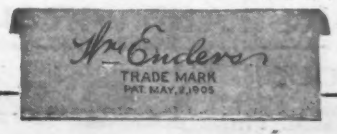
Shaving with an Enders Safety Razor is *"Just like wiping your face with a towel."*

Wm Enders

ENDERS SALES COMPANY, 17 Battery Place, New York

ENDERS SELLS FOR $1.00 with six blades of the best quality Swedish-base steel. Packed in a black Keratol box, velvet-lined. Extra blades—package of 5—35c.

FOR SALE BY BEST DEALERS EVERYWHERE



Does Dad Remember?

If dad will just think back to his boyhood days—if he'll just remember how much *he* wanted a bicycle—and how much fun he had when he actually *got* one—he won't let you be disappointed again *this* Christmas.

Good, healthy fun—quick, convenient, economical trips to school or work—wholesome, boyish companionships—*no* boy wants to be "the boy without a bike."

We back this Trade Mark with our reputation

¶ Write today for your dealer's name and copy of handsome new 1921 Dayton catalog No. 44 showing 8 models for men, women, boys and girls.

Dayton Bicycles

Cycle Division. THE DAVIS SEWING MACHINE CO., *Dayton, Ohio*

Free Book—LAW

Send for this Free 118 Page Book. It tells how you can gain a thorough knowledge of law in your spare time, as 40,000 others are doing. Splendid opportunities in the profession of law. Business today needs law trained men. Free book gives experiences of successful law trained men, and tells how you can read law under guidance of Ex-President Taft and 80 other eminent authorities.

Blackstone Institute
Dept. 1789, 608 S. Dearborn Street, Chicago

Dancing Made Easy

Learn Dancing at Home

In a few hours at home you can easily become an accomplished dancer by my amazing new chart system. Simple as counting. Learn Waltz, One-Step, Two-Step, Fox-Trot and all late dance steps. Be popular—the envy of the crowd. Thousands have learned this way.

Free Simply send name—a card will do—for book that tells about my marvelous new system. Special low rates now. Write me today. Prof. H. E. Wolfe, President.

WOLFE'S MODERN DANCE STUDIOS
108-C Wolfe Building, Kansas City, Missouri.

DO YOU LIKE TO DRAW?
Cartoonists are well paid

We will not give you any grand prize if you answer this ad. Nor will we claim to make you rich in a week. But if you are anxious to develop your talent with a successful cartoonist, so you can make money, send a copy of this picture, with 6 cents in stamps for portfolio of cartoons and sample lesson plate, and let us explain.

The W. L. EVANS SCHOOL OF CARTOONING
825 Leader Bldg. Cleveland, Ohio

$10 Brings This Latest Model **L. C. Smith** or a **Remington**
TYPEWRITER

Thoroughly rebuilt in our factory by the famous "Young Process." Fully guaranteed. Easy terms. No interest. FREE TRIAL. We handle all standard makes. Write for details.

YOUNG TYPEWRITER CO., Dept. 42, Chicago

"THERE'S MONEY IN IT"
LEARN TELEGRAPHY AT HOME
MORSE AND WIRELESS

TEACH YOURSELF in half usual time, at trifling cost, with the wonderful Automatic Transmitter THE OMNIGRAPH. Sends unlimited Morse or Continental messages, at any speed, just as an expert operator would. Adopted by U. S. Gov't, and leading Universities, Colleges and Telegraph Schools. 4 styles. Catalog free.

OMNIGRAPH MFG. CO., Dept. H., 26 Cortlandt St., New York.

Secret Marks Aid the Identification of Cars

IT is believed that at least one automobile out of every dozen manufactured and sold is stolen. How many stolen machines are ever recovered by their rightful owners, is another question.

Good locking devices, or thief signals, are not to be despised. They are a sure protection against depredations by meddlesome men and boys, and will cause the automobile thief so much trouble that he will look for a car that is easier to take away. Where several cars are parked, this will not be hard to find. Comparatively few cars are left well locked, and many stand without being locked at all. Owners sometimes forget to take the switch-key with them, leaving it in the switch-lock.

Should a professional automobile thief get your car, he will take good care that you will not recognize it should you see it again. You know it now chiefly by its license plates, car and engine numbers, and a few scratches, dents, and slight peculiarities.

He discards the license plates, changes the engine and car numbers, and obliterates every mark by which you might identify your car. Caution is his middle name. He likes to tear down several cars of the same make, and reassemble them so that no two of their principal parts will be found in any one car together. He has looked everything over with great care, to see whether your initials are hidden under a washer, or whether there are prick-punch holes anywhere concealed. Lest you identify some scratch or dent, he may use new fenders and repaint the car.

If you could make a decisive identification of a body, frame, engine, gear-case, rear axle-housing or front axle, you would stand the best kind of a chance to take that car away from a crowd of claimants, even if your markings could be found on but one of these parts.

How near can we come to a system of invisible markings, unlikely of chance duplication, and readily discoverable by the owner or some one authorized by him? There is safety in numbers. Several markings on each part make it less likely that all can be obliterated.

Take, for an example, the following memorandum of a secret mark: "7¾ in. horizontally to the left of center of the right engine suspension bolt, scrape off the paint and find a drilled hole filled with lead."

If you have several such marks, carefully recorded, on different parts of the frame, your identification will become more positive, as it is highly improbable that two or more of these marks would be accidentally duplicated by some other person.

Many other methods of marking the car will suggest themselves to the

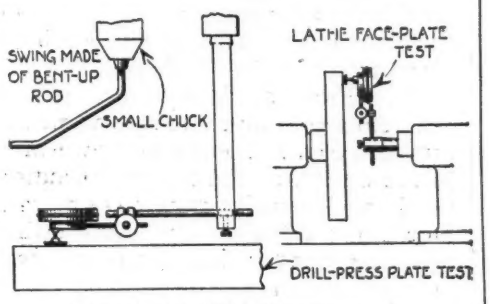
inventive owner. It must be remembered, however, that secret identification marks are worthless unless they are carefully and exactly recorded and a record of them preserved.—HENRY R. THAYER.

Using a Dial Indicator as a Sweep Tester

THE common practice of attaching a pointed sweep to the spindle of a drill-press or lathe to test the trueness of the table or faceplate has the disadvantage that it is rather difficult to see by eye whether the point is actually touching; in fact, it may be just clearing or pressing with considerable force. Chalking may relieve this, but it sometimes is difficult to chalk a smoothly surfaced table.

The better way is to mount a dial test-indicator upon the sweep, for then the exact measure that the table is out may be directly read.

The illustration shows an adjustable sweep made up for a heavy drill-press.



By using a dial indicator on the lathe the trueness of the faceplate may be exactly ascertained

The vertical piece is tapered to fit into the spindle sleeve and is drilled through at right angles near the bottom for the horizontal rod which carries the dial. A set screw holds the rod in place.

For a small light drill-press provided with a nut, a piece of steel rod may be bent up to suit, the vertical end being held in the chuck. In testing lathe faceplates, an adapter may be made to fit the tailstock quill, drilled at right angles for a rod like the first one and a set screw put in to clamp the rod.

The adapter should make an accurate, scraped fit into the tailstock taper, driven in rather tightly, and then the tailstock screw slackened off just enough to loosen the adapter so that it will turn rather stiffly. The indicator may be set at any distance out on the rod.—H. H. PARKER.

Home Soldering Made Easy with a Good Flux

DOES your wash-boiler leak? Close the leak with solder. Small soldering sets are sold for a trifle and are very useful in the house. A solution of sal ammoniac and borax makes a good soldering fluid, particularly for copper and brass. For tin the resinous flux supplied with the soldering-set may be used. Scrape the surfaces well before soldering.

Never Sleep

With a film-coat on your teeth

Millions of people on retiring now combat the film on teeth. They fight it day by day. And those glistening teeth seen everywhere now form one of the results.

You owe yourself a trial of this new teeth-cleaning method. Dentists everywhere advise it. The results it brings are all-important, and they do not come without it.

What film does

Your teeth are coated with a viscous film. Feel it with your tongue. It clings to teeth, enters crevices and stays. And dentists now trace most tooth troubles to it.

The ordinary tooth paste does not end film. So, despite all brushing, much film remains, to cause stain, tartar, germ troubles and decay.

It is the film-coat that discolors, not the teeth. Film is the basis of tartar. It holds food substance which ferments and forms acid. It holds the acid in contact with the teeth to cause decay.

Millions of germs breed in it. They, with tartar, are the chief cause of pyorrhea.

Ways to combat it

Dental science, after years of research, has found effective ways to fight film. Able authorities have proved their efficiency. Together they bring, in modern opinion, a new era in teeth cleaning.

These five methods are combined in a dentifrice called Pepsodent—a tooth paste which complies with all the new requirements. And a ten-day tube is now sent free to everyone who asks.

Watch the teeth whiten

You will see and feel results from Pepsodent which brushing never brought you heretofore. A week's use, we think, will amaze you.

One ingredient is pepsin. One multiplies the starch digestant in the saliva, to digest all starch deposits that cling. One multiplies the alkalinity of the saliva to neutralize mouth acids.

Two factors directly attack the film. One of them keeps the teeth so highly polished that film cannot easily cling.

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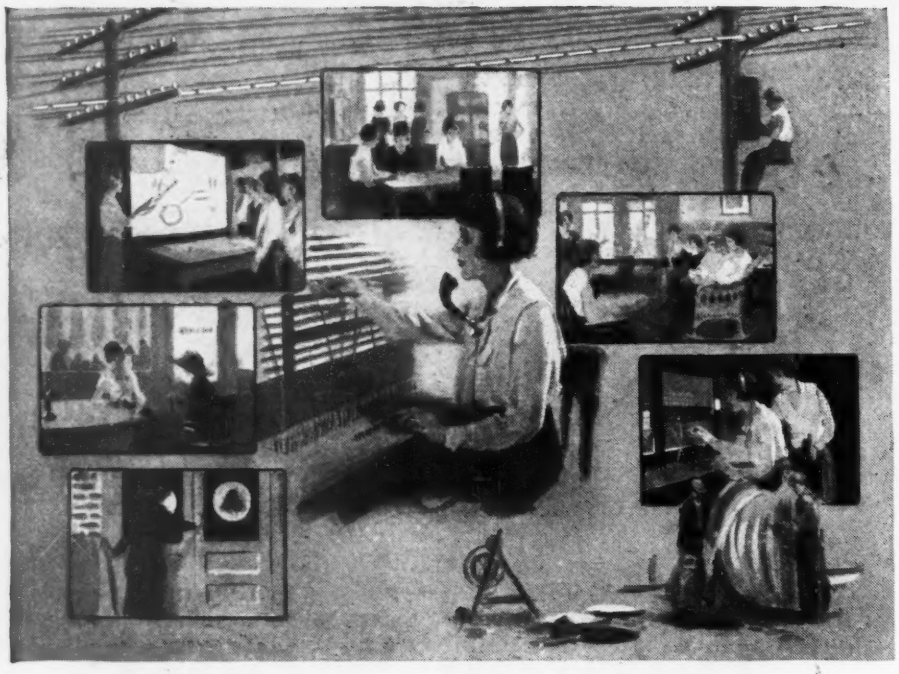

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A Combined Burglar Alarm and Keyhole Lighter

IF you are at home and any one attempts to turn the knob of your front or back door, a bell will ring. If you come home late in the evening, turn the knob yourself and a flashlight appears from the interior, displaying brightly the location of the keyhole. Such is the operation of a small outfit which will cost the maker not much more than one dollar and take but an hour's time to construct.

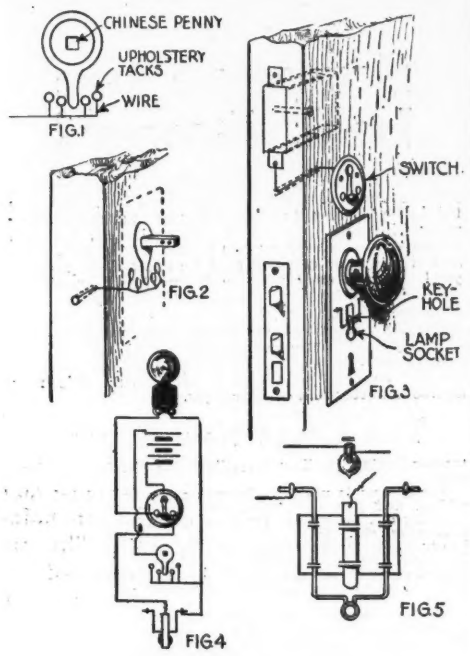
You may be able to purchase the following four things at a local five-and-ten-cent store: (1) A two- or three-point battery switch mounted on a wooden base; (2) A small flashlight battery; (3) a small flashlight bulb for same, and (4) a small electric buzzer or bell. If you succeed in this, the balance of the cash will purchase sufficient wire to make the connections.

On the inside of the door, take off the little plate or disk through which the doorknob handle protrudes. To do this it is necessary to take out the little screw which holds the knob in place, removing the knob and then the plate. From a piece of heavy tin, cut from an old tin can, make a pointer arm (see Fig. 1) having a square hole in the center, as the rod which holds the knob is usually square. This tin may be materially strengthened by soldering one or two (one on each side) Chinese copper pennies to the base. In this case it may be necessary to do some slight filing on the interior of the square hole so that it will fit the square rod.

When you return to your home late at night, you will find the illuminated keyhole very welcome

Placing the pointer on the rod, the latch remaining in normal position, place two round-head upholstery tacks on each side of the extremity of the pointer in the door, so that if the handle is turned the least bit either

way, the end of the pointer will come in contact with the head of a tack. These four tacks should be connected by a fine copper wire before being driven in completely, the wire extending through a small drill-hole to the edge of the door (see Fig. 2). The plate, if hollow, can now be replaced over this contacting device. If it is made of wood, it is an easy matter to cut a hole of sufficient size to allow free movement of the pointer. If the plate is solid metal and flat, take out the entire handle rod while counterboring a hole with an extension bit,



These diagrams and sketches show the detail of the combined burglar alarm and keyhole illuminator

large enough to sink the pointer and tack-heads so they will not come in contact with the plate when once replaced. About 1/8 in. should be sufficient.

Ten or twelve inches above the handle of the door, cut in from the edge a space large enough to accommodate the flashlight battery. In my case the battery was 2 1/4 in. long, 1 1/4 in. wide, and 5/8 in. thick, and I allowed 1/16 in. for variation of the thickness and 1/2 in. for variation of the length and depth. Two pieces of heavy tin whose width is about 1/4 in. shorter than the thickness of the battery and whose length is the same as the depth of the hole cut for the battery, are bent at right angles about 3/8 in. from one end. On the underneath side of the smallest end of each piece solder one end of a piece of copper wire before tacking the strips in their respective positions shown by Fig. 3.

A couple of tacks through the smallest end hold the strips in spring tension and the battery is slipped into position between, making contact at top and bottom. A round-head screw from the inside of the door holds the battery from jarring out.

Just below this battery pocket, but on the inside of the door, mount the

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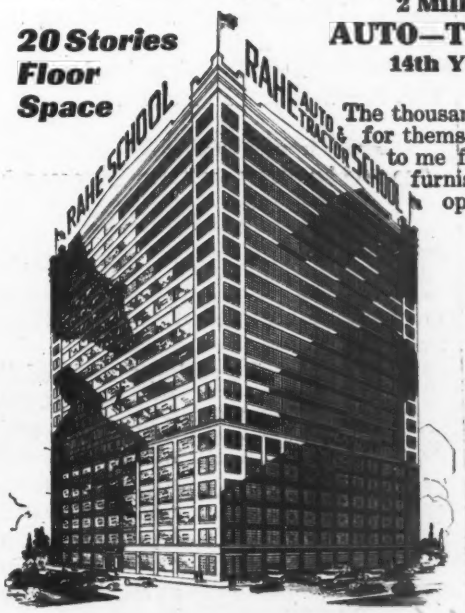

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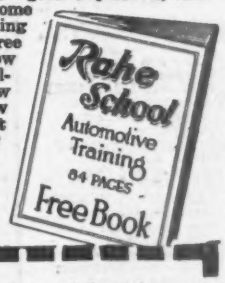

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two- or preferably three-point switch, the wire from the bottom tin strip in the battery pocket connecting to the lever arm of the switch. If it is a three-point switch, the middle or second contact should be used as the "off" position, and the contacts on either side connected respectively to the buzzer or bell and one side of the light receptacle described below.

Holding the small flashlight bulb in one hand and about 6 in. of No. 10 bare copper wire in the other, proceed to wind the wire around the thread in the base of the bulb beginning about the center of the wire. Three or four turns should be sufficient and a drop of solder placed on the outside will hold them in place. The ends should be straightened out and bent in the same direction. (See Fig. 4.) Slip a small piece of pasteboard on these ends, as shown, and bend the ends outward. A small strip of tin about $\frac{1}{8}$ in. wide and 1 in. long has a very fine flexible cord soldered to one end and the tin strip placed in slots in the cardboard so that when the flashlight bulb is screwed into the improvised wire socket, the bottom of the bulb will make contact with the tin strip. The bulb is placed in position and with the body of the bulb directly in the keyhole, mark on the door the location of the ends of the wire holder so that very fine staples or screw-eyes may be inserted to hold the ends of the wire.

It can be seen readily that in this manner the bulb can be turned back out of the way so that a key may be inserted in the keyhole from the inside of the door, such as locking the door at night-time.

The developed wiring is shown in Fig. 5.—THERON P. FOOTE.

An Attachment to Prevent Door-Slamming

THIS extemporized door attachment was quickly rigged up by a mechanic and applied to a lockless inner door.

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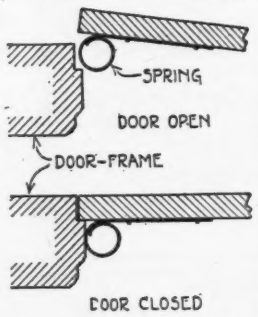
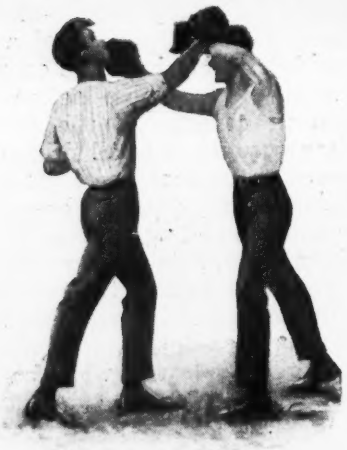


A simple spring attached in the manner shown will prevent the door from slamming

Brass spring wire is the best material for the spring. It should be sufficiently heavy and stiff and the loop should be large enough to resist pressure and hold the door firmly closed. If a slight indentation, rounded to correspond with the curve of the wire loop, is made in the place against which the spring rests when the door is closed, it will keep the door closed.



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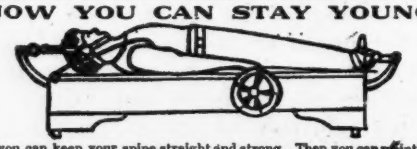

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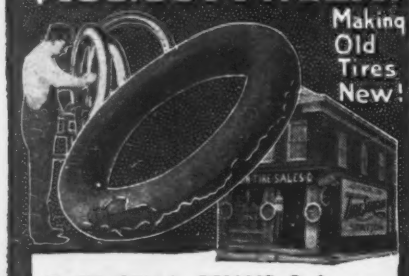

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G. H. LOCKWOOD, Editor, Dept. 613, Kalamazoo, Mich.

How to Construct a Small Farm Tractor

A SMALL tractor that can be built in the farm shop is shown in the illustrations. It can be constructed mostly of parts of old farm machinery and other scrap material. It is driven by a 12-hp. motorcycle engine.

It can do all the work that could be done by one horse, such as plowing with one plow, harrowing, cultivating, and pulling fairly heavy loads. Being equipped with a belt pulley, it can also be used to pump water, saw wood, run dairy machinery, charge the batteries of a lighting system, run an ensilage cutter, corn-huller, or any other belt-driven machinery.

The frame of the machine is of 2½ by 4 in. ash, put together with ½ in. bolts. The corners are strengthened with angle-irons made of 3 by ½ in. iron. All dimensions are given in the plan view. The bull wheel is made of two old mowing-machine wheels bolted together with 14-in. lengths of 2 by ½ in. L-shaped angle-iron. The wheels are mounted on a 1½-in. shaft, which is provided with roller bearings. The bearing mounting is shown in Fig. 5. The bearings are made as dust-tight as

A motorcycle engine and some parts of old machinery will help make a practical tractor for use about the farm

possible by a heavy leather washer at each end, held in place by a steel washer which is turned with a shoulder so that it can be fastened to the shaft.

The driving-gears have a 1½-in. face. They are mounted on 1¼-in. shafting with babbitt-lined pillow-blocks for bearings. These are made dust-tight in the same manner as the roller bearings. The ratio between the gear on the bull wheel and the driving-gear is four to one.

The two outside gears should be 12 in. in diameter. The small gear on the belt-pulley shaft is 3 in. in diameter. The clutch on this shaft can be constructed as shown in Fig. 1, but if this type is used, it will be necessary to have an engine which is equipped with a clutch so it can pick up the load gradually. If an old automobile clutch can be obtained and mounted on the belt-pulley shaft a plain sprocket can be used on the engine. The shaft should turn at one half the engine speed. The method of fasten-

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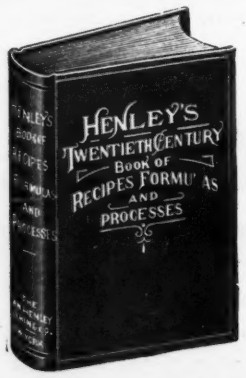

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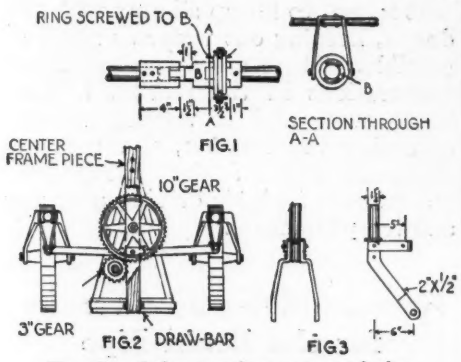
ing the driving sprocket to the shaft is shown in Fig. 4. The sprocket is bolted to a gear which is fastened on the shaft by a key or set screws. The belt pulley is eight inches in diameter with a 5-in. face.

The rear wheels are 16 in. in diameter. Steering-gear details are shown in Fig. 2, and the rear wheel fork in Fig. 3. Fig. 6 gives a rear view

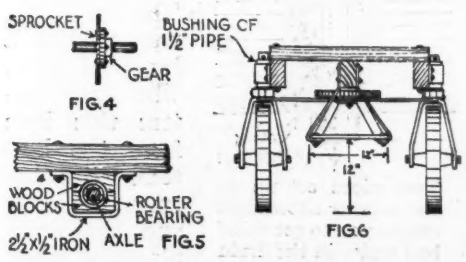


Details of the steering gear and the construction of the forks of the rear wheels are shown here

of the steering gear and also shows the position of the drawbar.

If desired, a long crosspiece can be used at the rear of the frame and the wheel forks attached to it 4 ft. apart so the machine can be used to cultivate between rows 2 ft. apart. The seat and the rear wheels can be obtained from old farm machinery.

An air-cleaner must be fitted to the engine. One can be bought from a tractor dealer. This is important, as an engine which is constantly sucking



These diagrams illustrate the method of fastening the driving sprocket to the shaft and give a rear view of the tractor

in dust will run for about a week and then be ready for a rest while new cylinders and pistons are being fitted.

A cooling fan is mounted on the right-hand outside frame piece. The fan can be driven from the belt-pulley shaft.

The gasoline tank is mounted on scrap-iron standards on the center frame crosspiece as shown in the elevation. — CLIFFORD A. BUTTERWORTH.

Winter Weather Is Very Hard on Tires

WINTER-TIME is a hard period for automobile tires. Because of changing temperatures, standing in the freezing cold part of the time and kept in a warm garage at others, even tiny cuts in the tread are more apt to

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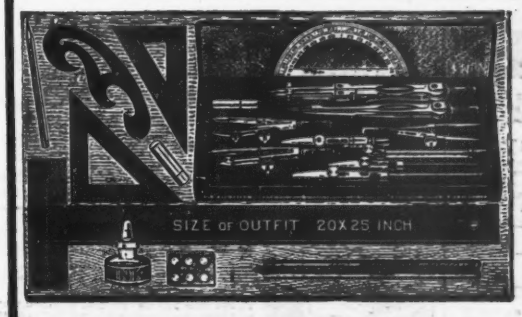

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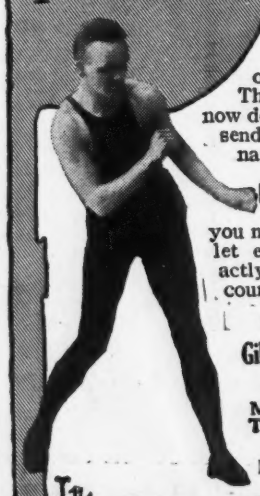

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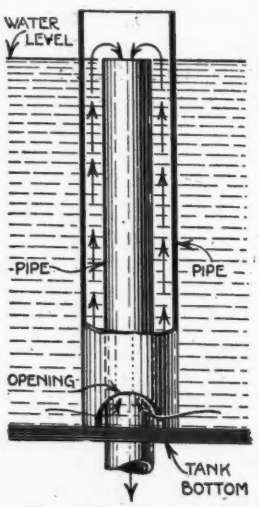
develop into big holes than in summer. Particles of ice and snow will lodge in the little cuts, and when the car is put in a warmer place, this ice will thaw, wetting the fabric and leading to a gradual disintegration of fabric and tread. When the moisture again freezes, it serves to do further damage. Thus the alternate thawing and freezing develops small tread cuts into serious tire maladies.

It is best to fill up all cuts with tire dough, keeping out water as much as possible. There are several excellent preparations in the market to heal tread cuts, and if applied strictly according to direction, the cuts are effectively sealed against the deleterious effects of winter driving over wet and icy pavements.

How to Make an Overflow for the Drain-Pipe

A SIMPLE and effective overflow which removes the lower bad water without discharging the upper fresh water can easily be installed. It consists of the usual drain-pipe reaching to the level at which it is desired to keep the water. Over this pipe a larger pipe is fitted which extends a short distance above the overflow. The lower extremity has a large opening. The water enters this hole from the bottom, rises between the outer and the inner pipe, and, when it has reached the top of the shorter pipe, overflows and is carried off in the usual way.

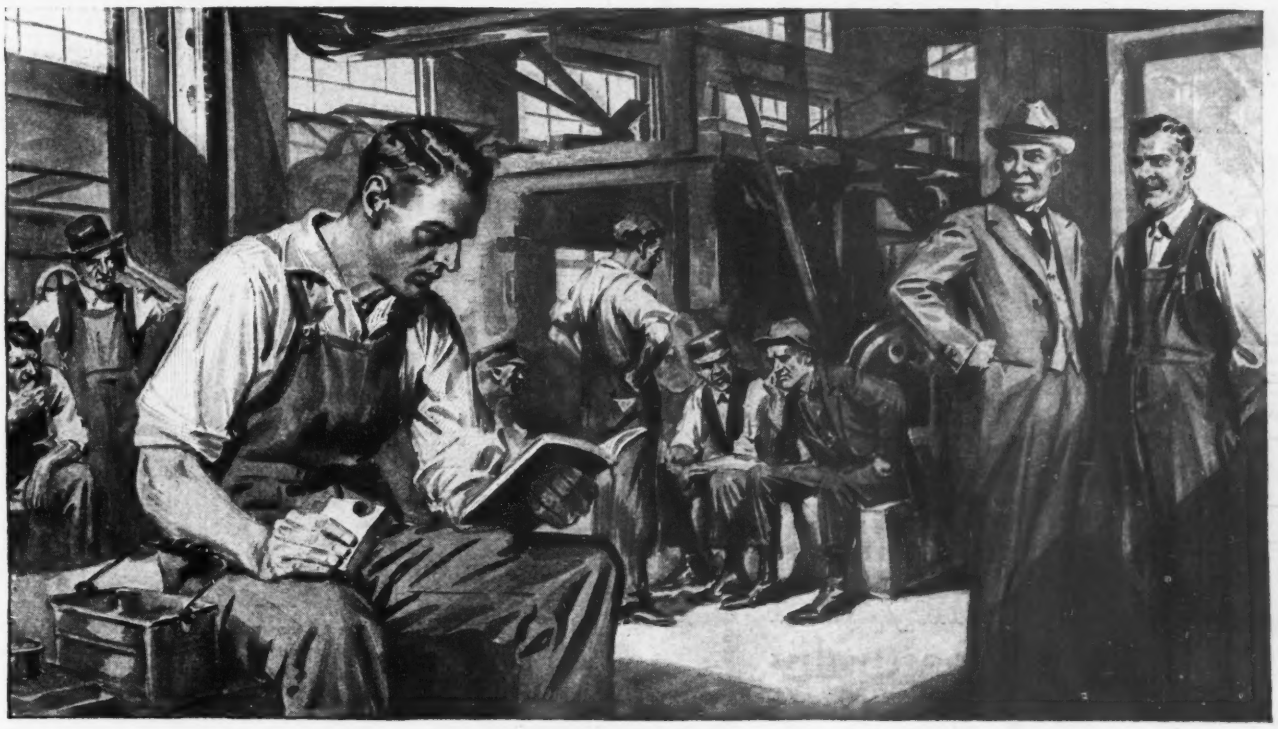


Two pipes set up in the manner shown will enable you to get rid of bad water in the drain

This device is inexpensive and easily set up without special tools, and farmers as well as dwellers in the suburbs will find it very useful.

How to Case-Harden Small Articles Quickly

SMALL articles, like expander pins, etc., can be quickly case-hardened by plunging them, at bright-cherry heat, into a box containing cyanide of potassium crystals, and then quenching the pieces at a dull-red heat. Cyanide of potassium is a deadly poison and should be handled with great caution. The operations of case-hardening should be performed in the open air, and the operator should stand on the side from which the wind blows.



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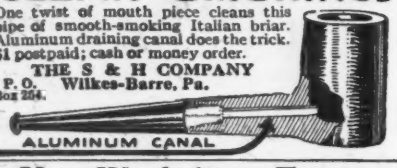

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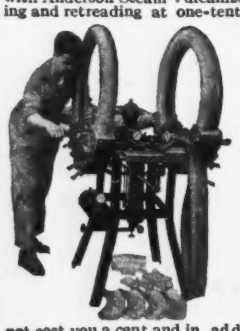

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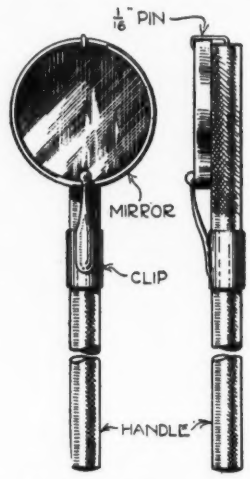
An Adjustable Handle for a Small Mirror

THE illustration shows a novel arrangement for holding a small mirror securely. It is designed to be



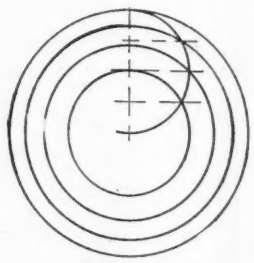
A piece of tubing, a pencil clip, and a pocket mirror make an excellent arrangement for use about the machine-shop

carried in the pocket and is invaluable for shop use.

The handle is made of a piece of ordinary brass tubing. A small pin clamps the mirror at the top as shown. The bottom of the mirror is held in place by a pencil or fountain-pen clip.—J. W. MOORE.

How to Make Rings of Equal Areas

DIVIDING a disk into a number of rings all having equal areas can be accomplished by a long and tedious mathematical process—if one knows how. But it can be done just as accurately and a great deal faster with a ruler and a pair of compasses.



Constructing rings of equal area becomes a simple matter if you use this geometrical method

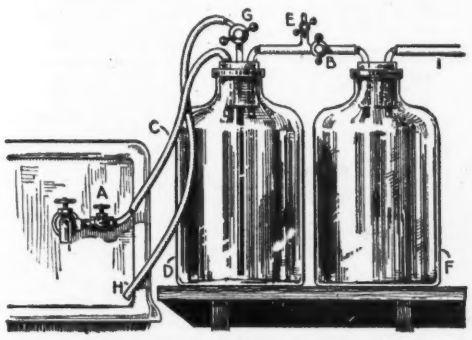
Lay out the circle and draw a radius line—that is, a line from the center to the circumference. Find the center of the radius and from that describe a semicircle touching the center of the big circle and the circle itself. Divide the radius into as many equal spaces as the desired number of circles, and from each division point erect a line perpendicular to the radius and cutting the semicircle. Then proceed to draw the rings, each of which must cut the intersection of a line with the semicircle.

This done, all the rings will have the same area, and the area of the central circle will be the same as that of any one of the rings. If you wish to obtain exact results you will have to draw carefully.

An Inexpensive Aquarium Air-Pump

WHEN animals are kept in a salt-water aquarium it is absolutely essential to aerate the water thoroughly, to make it possible for the fish to live in it. For this purpose some kind of an apparatus must be procured. But these devices are all expensive and quite intricate in design. Therefore a man with a hobby for aquaria and aquatic life will certainly appreciate an apparatus simple in construction and easy of manipulation.

All that is necessary for such a pump are two large, heavy bottles both of the same size, some rubber tubing and glass tubing, two rubber stoppers, and three metal pinchcocks. Bore two holes in one stopper and three holes in the other, and arrange the tubing as shown in the diagram. The rubber tube *C* connects the faucet *A*



This simple apparatus will efficiently solve the problem of aerating the water for your salt-water aquarium

with bottle *D*. The pinchcocks are placed at *G*, *E*, and *B*.

Now let the water run into the bottle *D*. The water will force the air from this bottle into the reservoir *E*. When *D* is full of water, the faucet is turned off, the pinchcock *B* is closed and *G* is opened. There is now one atmosphere in bottle *F*. When pinchcock *E* is opened, the water will be forced out of bottle *D* through the long glass tube into the rubber tubing *H* and into the sink by the remaining pressure in the bottle *D*. As soon as the water begins to run out of the tube *H*, open cock *E* so that all of the water will siphon out of the bottle. The tubing *I* leads to the aquarium to be aerated.

A judicious aeration will not only clean the water, but will keep it in circulation, which is a very important consideration in a salt-water aquarium.—ERNEST BADE.

A Graduated T-Square for Section Lining

IN drafting or engineering drawing, the process of section lining is very tiresome, especially as care must be taken that the lines are equally spaced. For the beginner especially is this a difficult task.

A very simple yet efficient method of maintaining accuracy in the spacing of section lines is to graduate the upper edge of the T-square to correspond

The water swirls through the clothes in a figure 8 motion four times as often as in the ordinary washer.

ALL the cuddly soft baby things can be popped in the gleaming copper tub of the 1900. Out they come, snowy white and fresh as new, to adorn baby's chubby, pink person!

I'm the figure 8!

IN fact, everything can be washed in the 1900, even heavy sheets or blankets. The cleansing, soapy water rushes back and forth through the clothes in that magic figure 8 movement, swishing through them with *every motion of the tub!* This figure 8 movement is the magic exclusive feature that makes the 1900 the perfect washing machine.

And there are no parts in the tub to cause wear and tear, or to wrench off buttons. The swinging reversible wringer works electrically, and the entire cost of running the 1900 is only a few cents an hour. When you think of the 1900 remember that magic figure 8!

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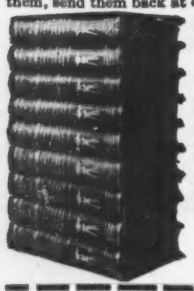

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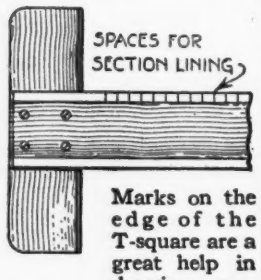
with the desired spacing, as shown in the illustration.

Except in very small drawings, section lines are never less than 1-16 in. apart. For general work, 3-32 in. is possibly the most practical distance for spacing the lines.

The upper edge of the T-square should be divided into spaces of 3-32 in. for general work. Another square should then be placed along the edge of the T-square, and lines, corresponding to the division marks, scratched into its surface by means of some sharp-pointed instrument.



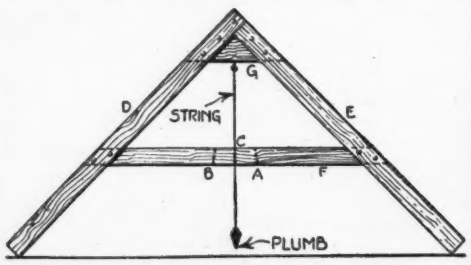
Marks on the edge of the T-square are a great help in drawing section lines

If any special spacing is desired for a certain type of work, that distance may be used instead of 3-32 in. Great care should be taken not to scratch or mar the working edge of the T-square, the lines being scratched only on top.—J. EDWARD WHITE.

Improvising a Simple Level on the Job

OFTEN a rough leveling of some surface is needed when a large level is not available. The writer has often used the following scheme for leveling and found it to be as accurate as that obtained with a spirit level.

Take two pieces of wood about 4 ft. long and nail to a short piece of plank, such as the two pieces *D* and *E*, and nail to the piece *G*. Nail a crosspiece *F* between the two legs as shown. Fasten a screw-eye to the piece *G* and hang from it a piece of string to which



From a few strips of lumber, a string, and a plumb this serviceable grading level may be made

is fastened a plumb-bob or any heavy piece of metal or wood that will keep the string taut.

Now place the frame in a vertical position with the two legs resting firmly on the foundation. Mark with a pencil the place where the string passes the crosspiece *F* at the point *A*. Then reverse the position of the legs upon the same foundation and mark at the point of the string intersection with *F* at *B*. Then take the rule and measure the distance between *A* and *B*, and at the center of this distance make a permanent line *C*. Now when

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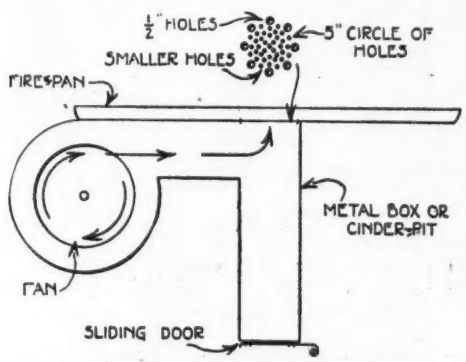
the frame is placed upon a perfectly level place, the string should be in line with *C*.

In leveling up surfaces it is only necessary to get the plumb-line to intersect at the mark. When making the level, it is necessary to have the two feet rest upon two surfaces, one to be considerably higher than the other. The side legs may be of uneven lengths and nailed together at any angle.—B. F. DASHIELL.

Old Materials Made This Useful Forge

THE man who made the forge shown below uses it often on his ranch, where he does all his own blacksmithing.

The forge is made entirely of old materials. The fire-pan was made from the bottom of an old cookstove. Two legs 30 in. long, made of 2 by 2 in. lumber (rescued from the kindling-pile), and two legs 42 in. long, made from 2 by 4 in. stuff, are securely braced. A sheet-iron guard placed on



This forge, made entirely of old materials is the clever invention of a rancher

one end and part of one side above the fire-pan helps to control the fire.

The fan is made like the fan of a fanning-mill, and is contained in a metal-covered drum which confines the air current and carries it to the metal box that serves as a cinder-pit, the top being bolted to the fire-pan. Care must be taken that this joint is an airtight one, as immediately above this metal box are the perforations in the fire-pan for the draft.

The bottom of the cinder-pit is closed with a sliding metal door. The large wheel was taken from a worn-out washing-machine and belted to a small pulley on the end of the fan-shaft. A three-point lever carries a little pulley which acts as a tightener and is held taut by a coil spring.

The metal used in the drum and metal box is old 12-gage black iron, taken from old smudge-pot covers that had passed their days of usefulness.—R. D. SHULTIS.

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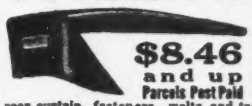

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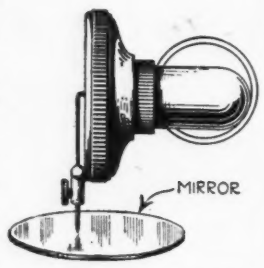
around and up so the operator can see to put in a new needle. Instead, he has to feel underneath for the needle socket and put the new one in by that means.

This difficulty can be relieved by placing a small pocket-mirror on the top of the cabinet so it will be directly beneath the reproducer when it is brought back in the starting position previous to placing on a new record.



By looking in the mirror you can see the needle socket and easily insert the needle

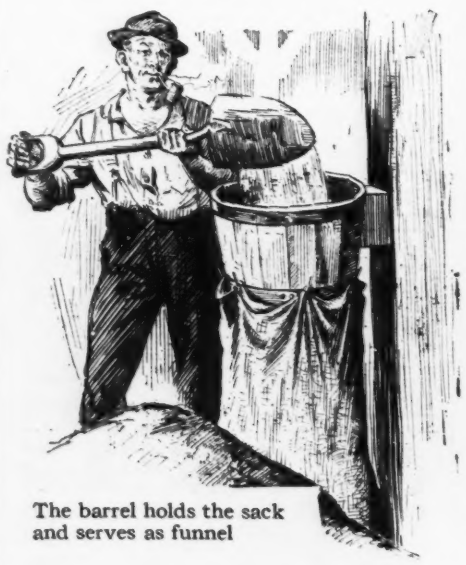
Then, by looking in the mirror, when the reproducer and tone-arm are raised, the needle socket can be seen without having to twist your neck out of shape in an attempt to look up from underneath.

If desired, the mirror can be set permanently into the cabinet by gouging out a socket for it in the wood and securing it in place with screws.

A Sacking Device that One Man Can Operate

A NEW device for holding sacks during filling should save backs and a lot of useless adjectives for one compelled to work alone.

It consists of half a pickle barrel with the end knocked out, and attached to the side of the bin or granary where most convenient with a small block of wood.



The barrel holds the sack and serves as funnel

Five or six nails, driven through the sides of the barrel from the inside and pointing at an upward angle when the barrel is in place, holds the sack in position during the filling. The sack is pulled up over the bottom of the barrel as shown, and the nails hold it. This should be at the right height from the floor to allow filling of the sack, and yet so that the sack will touch the floor, preventing any weight from coming on the nails and causing tearing.—DALE VAN HORN.

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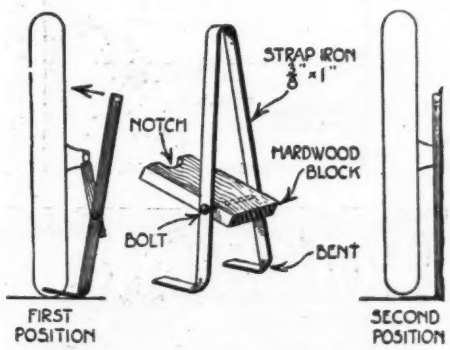
An Automobile Jack that Is Quick Acting

IT is possible to prolong the life of automobile tires if the car is jacked up as often as possible when not in use. During the night, and at other times when the car is in the garage, which usually represents more than half of the time, the car might just as well be raised from the floor, saving that much weight on the tires. Extra load is not only removed from the tires, but any tendency toward flattening of the shoe and making its wearing qualities uneven is lessened considerably.

A set of homemade jacks will not take long to make, and once made and put to use, will much more than pay for themselves in a few months.

The construction of the jacks is simple. A 6-ft. length of strap iron ¾ in. in thickness and 1 in. wide is required for each jack. This is bent nearly double in the center, and each end provided with a right-angle turn and four inches turned to slightly more than right angles with the length of the jack. A block of wood, preferably hard wood, is cut from a 2-by-6 about 10 in. in length, and a notch cut in one end as shown to fit the under side of the wheel-hub. This is then bored for a ¼-in. bolt an inch from the other end and holes to match drilled through each side of the jack at a height which will place the bottom of the notch on a level with a point about the center of the wheel-hub. It will be necessary to taper the block to fit the two sides of the jack and allow the bolt to be fitted tight. The feet of the jack should be spaced far enough apart so that each can be placed on one side of the tire.



These four jacks will relieve the tires of the weight of the automobile

The illustration shows how the jack is used. The first position shows the feet of the jack placed tight against the tire with the notch of the wood block against the under side of the wheel. When the top of the jack is pushed in toward the wheel, the action raises the wheel about 2 in. and transfers the weight from the tire to the hub. The feet afford sufficient bearing to enable the car to stand rigidly when four jacks have been applied and remove all possibility of its shifting to one side and back to the floor.—DALE VAN HORN.

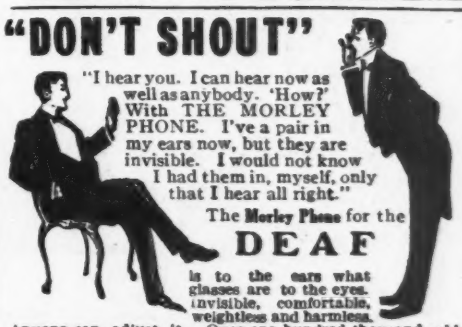
Sloan's Liniment
The World's Pain's enemy

relieves rheumatic aches and pains

KEEP Sloan's Liniment handy to put the "feel good" back into the system. All it needs is just one trial—a little applied *without rubbing*, for it penetrates—to convince you of its merit in relieving rheumatism, sciatica, lumbago, neuralgia, lame muscles, stiffness, bruises, pains, backaches, strains, and the after-effects of exposure.

The congestion is scattered, promptly, cleanly, without effort, economically. You become a regular user of Sloan's Liniment, adding your enthusiasm to thousands of other friends the world over, who *keep it handy* in case of need. At all druggists.

"DON'T SHOUT"



"I hear you. I can hear now as well as anybody. 'How?' With THE MORLEY PHONE. I've a pair in my ears now, but they are invisible. I would not know I had them in, myself, only that I hear all right."

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is to the ears what glasses are to the eyes. Invisible, comfortable, weightless and harmless.

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Established 1810
110 Years of Making Good Brushes
Replaced foreign brushes in the U. S. in 1812, and became soon the leading manufacturers of Brushes in the United States. Later, and now, the largest manufacturers of Brushes in the world. Excellent quality; infinite variety of all kinds of Brushes.
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John L. Whiting-J. J. Adams Co., Boston, U.S.A.
Brush Manufacturers for Over 110 Years and the Largest in the World

When Johnny has the Croup!

That's a cough with a croupy rattle, so hurry for the Musterole and rub it in right over the chest and neck. How it will tingle at first and then grow ever so cool. And how it will reach in and penetrate right to the spot! It will dissipate all the stuffy congestion which causes that hacking cough.

Why *shouldn't* grandmother swear by Musterole for colds and coughs? It is better than a mustard plaster—good as *that* was in the old days. And the explanation is this:

Musterole is made of oil of mustard and other home simples. It penetrates under the skin, down to the part. Here it generates its own heat, and this heat disperses the congestion. Yet Musterole will not blister. Musterole, on the contrary, feels delightfully cool a few seconds after you apply it.

Try Musterole for Bobby and Helen and Dorothy's croup—and for your own cough, too. Try it for rheumatism—it's a regular router out of all congestions. Always keep a jar handy.

Many doctors and nurses recommend Musterole.

35c and 65c jars—$3.00 hospital size.

The Musterole Co., Cleveland, Ohio
BETTER THAN A MUSTARD PLASTER

MUSTEROLE
WILL NOT BLISTER

WARNER'S "INFALLIBLE AUTOMATIC"

32 CAL.

15 QUICK SHOTS, NO JAMS

"THE PISTOL That Shoots and Hits the Mark"

Before buying ask your dealer about the $18 Warner "Infallible." Get the best and save at least **$5**

Get a **Warner "Infallible" Automatic** and teach the women how to plug the bull's eye. Target shooting is intense, exciting sport. Excellent training for nerves and eyes. Teaches self-reliance, confidence and familiarity with weapons. **What a Shooter Says:** "Your **"Infallible" Automatic Pistol** is all that you claim and more. I put seven shots in bull's eye one inch in diameter at distance of twenty-five feet with the pistol. The accuracy of this arm is unsurpassed by any regardless of price." C. S. Hoffman, 167 Oakwood Avenue, Orange, N. J.

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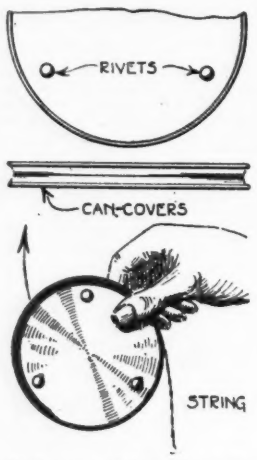
An authority has prepared for us, a set of six lessons on the **Art of Pistol Marksmanship.** These lessons are of marvelous value in the use and care of a **Warner "Infallible" Automatic.** Write today for illustrated circular and terms of **Free Lesson Offer.**

PRICE $8.00 WITH 2 MAGAZINES

KIRTLAND BROTHERS & CO., INC.
96 Chambers St. (Dept P-S.) New York

How to Throw Lines Over High Objects

RECENTLY, in line construction, workmen had occasion to get a very small line over high wires. The line which was to be sent over was, of necessity, very light, and some means was necessary to get it over without breaking. The thread attached to a stone, if thrown over, might injure the glass windows on either side, and so the job was done in the following fashion:



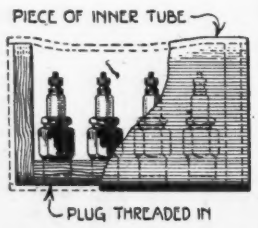
Coil your string about the rim of two can-covers, and you will easily throw it over a high wire

Two gallon-can covers were procured and the two held together with the rims outward. The thread was knotted and the knot wedged between the two disks and the rest, some hundred feet, coiled about the rim.

This was held in the manner shown and easily cleared the wire in question.—DALE VAN HORN.

Make a Safety Spark-Plug Carrier Box

HOW often has the motorist carried his spare plugs in the tool-box rolled loosely in an old cloth, only to find in an emergency on the road that the spark-plugs have shifted about in the tool-box with wrenches, etc., and every one has a broken porcelain insulator? The illustration will serve to show how this is overcome. This carrier box is made from three pieces of wood the cover of which is made from a few inches of an old inner tube.



Spark-plugs may be safely carried in a carrier like that shown here

Drill out the largest piece of wood that is to take the screw portions of the plugs, the diameter being such that the threaded end can be screwed in, making its own thread in the wood, which should be quite soft. After passing the plug down with a wrench the first time, the impression will be plain enough to render further use of the wrench unnecessary.

The end pieces are not in the way of the fingers when one is inserting or removing a plug, and they afford protection to the plug porcelains and terminals.

Learn to Dance!

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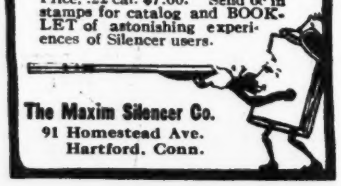
Price, .22 cal. $7.00. Send 6c in stamps for catalog and BOOKLET of astonishing experiences of Silencer users.



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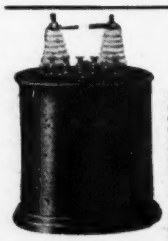


Packard

Owners of the ½ K. W. 13,200 high voltage type report distances of 450 to 900 miles. This cannot be equalled, using any other make of wireless transformer for amateurs. Adjustable power, large overload capacity and safety spark gap are but a few of the many good points. With the Packard you will be leader of all operators in your district.

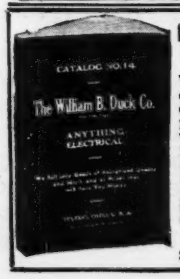
For this is the most powerful transformer that can be used for amateur purposes under government regulations.

Write for our Bulletin on Wireless Transformer.

Warren, Ohio

The Packard Electric Company

Wireless Transformers



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Wireless catalog mailed for 12c and electrical catalog for 6c. You may deduct this amount on first $1.00 purchase. Catalog not sent otherwise. Any wireless amateur will tell you it is the one catalog to have. As an encyclopedia of information it is invaluable. The largest and most elaborate radio catalog published. Values that cannot be duplicated elsewhere.

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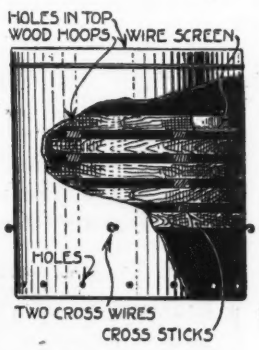
A Lard-Can May Be Used to Dry Fruit in

THE common 50-lb. lard-can, which may be bought at almost any grocery for forty cents, can with a very little work be converted into a cook-stove evaporator for the drying of fruits and vegetables. With three circular trays that fit inside, it has a capacity of 10 lbs. or more at one filling, and when a steady fire is kept in the stove, the drying will be completed in five or six hours.

Such cans are from 12 to 15 in. in diameter; the trays may be made of simple wooden hoops with bottoms of wire screening like that used in a coarse sieve. Six inches from the bottom of the can four holes are punched in the side and strong cross-wires put in to support the bottom tray.

The other trays are each supported by cross-sticks that rest on the tray beneath. In the top of the can and also around the side near the bottom, a number of small holes are made to provide for a free circulation of heated air through and about the trays of fruit. The bottom of the can may be cut out or it may be left as it is without any difference in the results.



A lard-can makes an excellent fruit dryer or evaporator. Three circular trays fit inside

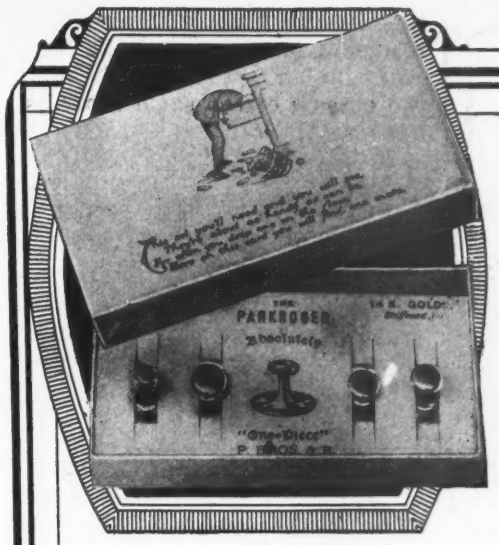
When the trays are filled with the sliced fruit and placed in the can, the material in the bottom tray, being nearest to the source of heat, will naturally dry first. When this is removed, the next tray above is placed at the bottom. Then the first tray should be refilled with green fruit and placed on top. Thus the fruit in the trays encounters increasing temperature as it is moved down each time, resulting in a more uniformly dried product than when left in one position.

An evaporator of this kind will take up little room on top of a range, and the drying may be done while the stove is used for baking, a few hours every day. The product will be much superior to that dried in the sun, and no damage will result from insects.—H. F. GRINSTEAD.

A Quick Way of Tightening Loose Flywheels

IT is common practice for the mechanic who undertakes the job of tightening a loose flywheel, in instances where the flange of the crankshaft is bolted to the flywheel web, to ream holes in the flange and fit larger bolts.

Instead, he could save time by



For "DAD" and the BOYS

SOMETHING you would never think of! An inexpensive gift giving year 'round comfort to the man who gets it—the Parkroger Collar Button Gift Box, containing *four* of the famous

"PARKROGER"
ABSOLUTELY ONE-PIECE COLLAR BUTTONS

The man who receives this gift doesn't miss trains hunting collar buttons, or find himself suddenly without one. He has a button always at hand.
Remember these are the famous PARKROGER ABSOLUTELY ONE-PIECE Collar Buttons. Made of a single piece of metal, gold plated on *both* sides. Base can't wear loose and come off as with other buttons. PARKROGER Buttons can't stain or poison the skin.

The Gift Box sells for $1.00 at all jewelry and men's furnishings stores.

PARKS BROS. & ROGERS, INC.
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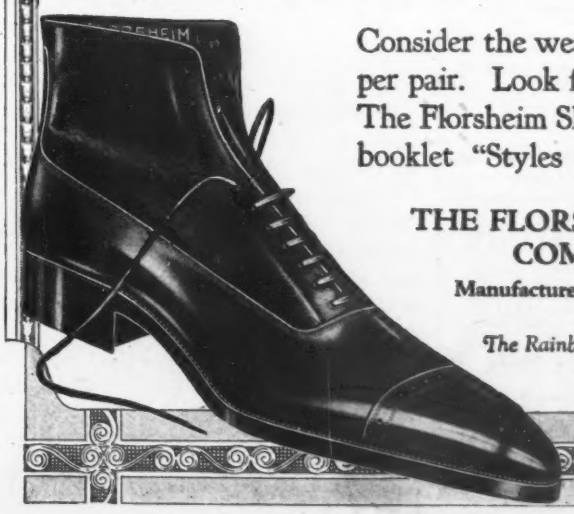
FOR THE MAN WHO CARES
The Florsheim SHOE

WE cannot afford to make disappointing shoes, and you cannot afford to buy them. Our reputation is worth too much to us; and your comfort, satisfaction and money are worth too much to you. We've kept on turning out Florsheim quality—you can keep on enjoying it.



Consider the wear not the price per pair. Look for the name—The Florsheim Shoe. Write for booklet "Styles of the Times."

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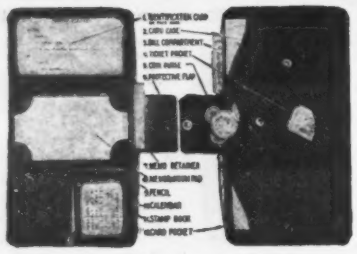
Manufacturers Chicago

The Rainbow—Style M-55

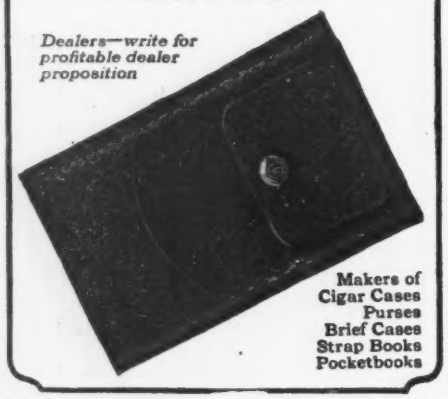


A Bill-Fold for Every Purpose

You can put system in your pockets with an "American Gentleman" bill-fold. It combines neatly and compactly 12 features that are useful every day. (See picture.) Strongly made of genuine leather. Stitched throughout, no edges pasted. Choice of black or tan. There is a distinctive look to the "American Gentleman". It is a bill-fold to be proud of. Buy one for $1.50 at any dealer's. Or send $1.50 with your dealer's name and we will mail you one postpaid.

Charles K. Cook Company, Inc.
Dept. D, Camden, N. J.

Dealers—write for profitable dealer proposition



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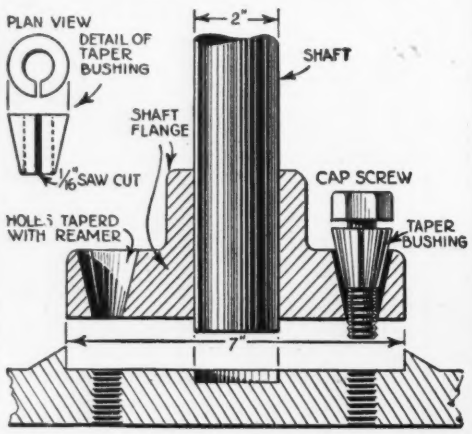
reaming this flange with a quick taper reamer, trimming a bushing for each bolt, and boring to fit the old bolt with the outside of the same taper as the reamer. One saw-cut is made through



The bolt pushing down the bushing pulls the crankshaft flange tight against the flywheel and holds it permanently

the bushing, allowing for expansion, and then the whole is screwed up, setting up snugly occasionally by tapping lightly with a hammer.—P. P. AVERY.

Roll Your Ladder Instead of Carrying It

WHAT is the use of carrying a long ladder on your shoulder or dragging it through the streets when two small wheels fastened to the legs near the base will make it a wheelbarrow?

The illustration shows how a painter put to further use the rear wheels of a worn-out express wagon, originally belonging to his young son. The wheels were left on the squared axle, which was just long enough to reach across the bottom of the ladder. The axle was secured with two light strips of strap iron fastened in the manner shown.—DALE VAN HORN.

Wheels on that clumsy ladder enable you to push it about easily

To Protect Automobile Tires and Tubes

THE automobile tire and its accompanying inner tube are the vital parts to be considered on a long tour or in the usual day's run. To keep them for use in emergency cases on the road is a thing to be appreciated by all owners and drivers. A few suggestions are well worth considering, inasmuch as they are offered from practical experience.

To keep the inner tubes safe and free from injury during driving, they should be protected against moisture, dust, and grit, as these affect them to an unlimited extent. To prepare a tube for storage, remove the valve-

Hang Pictures on Needle Points.

By a simple twist of the wrist, place Pictures Charts or Drawings, on any surface with

Moore Push-Pins

Glass Heads—Steel Points

Harmonize with any color scheme; can be used over and over. For heavy Pictures, Mirrors, Hanging Bookshelves, etc., use

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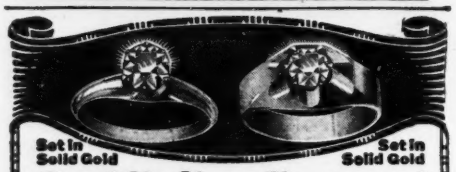
for comfort
Every pair guaranteed
MADE AT SHIRLEY MASSACHUSETTS



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Write Today Send your name now. Tell us which solid gold ring you wish (ladies' or men's). Be sure to send your finger size.

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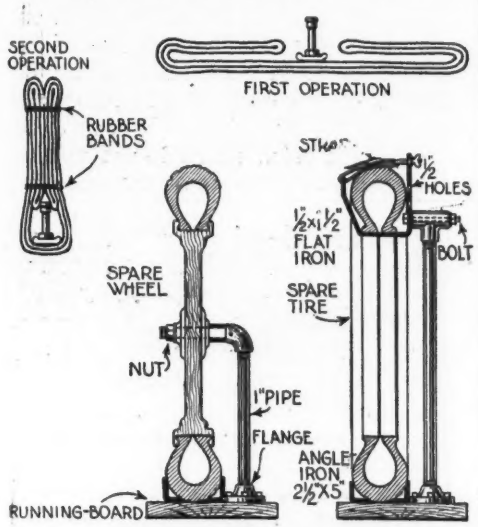
spring and -plunger from the inside of the valve-stem, and roll the tube up so that all the air is expelled. Holding it still compressed, re-insert the valve-plunger and screw it up tight, after which, screw on the valve-cap. The tube then will lie absolutely flat and should be folded as shown in the illustration, and an elastic band made from a strip cut off the end of an old inner tube around it, as shown. One at each end will make a complete job.

The tubes should be carried in a wooden box with corrugated cardboard tacked to its inside walls. An ordinary skate-strap will be best for locking the box.

The tires are the next in line. To be kept in first class condition a tire should be kept in a position as near its real diameter as possible, and to provide for this a rack should be made on



If your spare tires and tubes are taken care of as described in this article, you will have no trouble from them

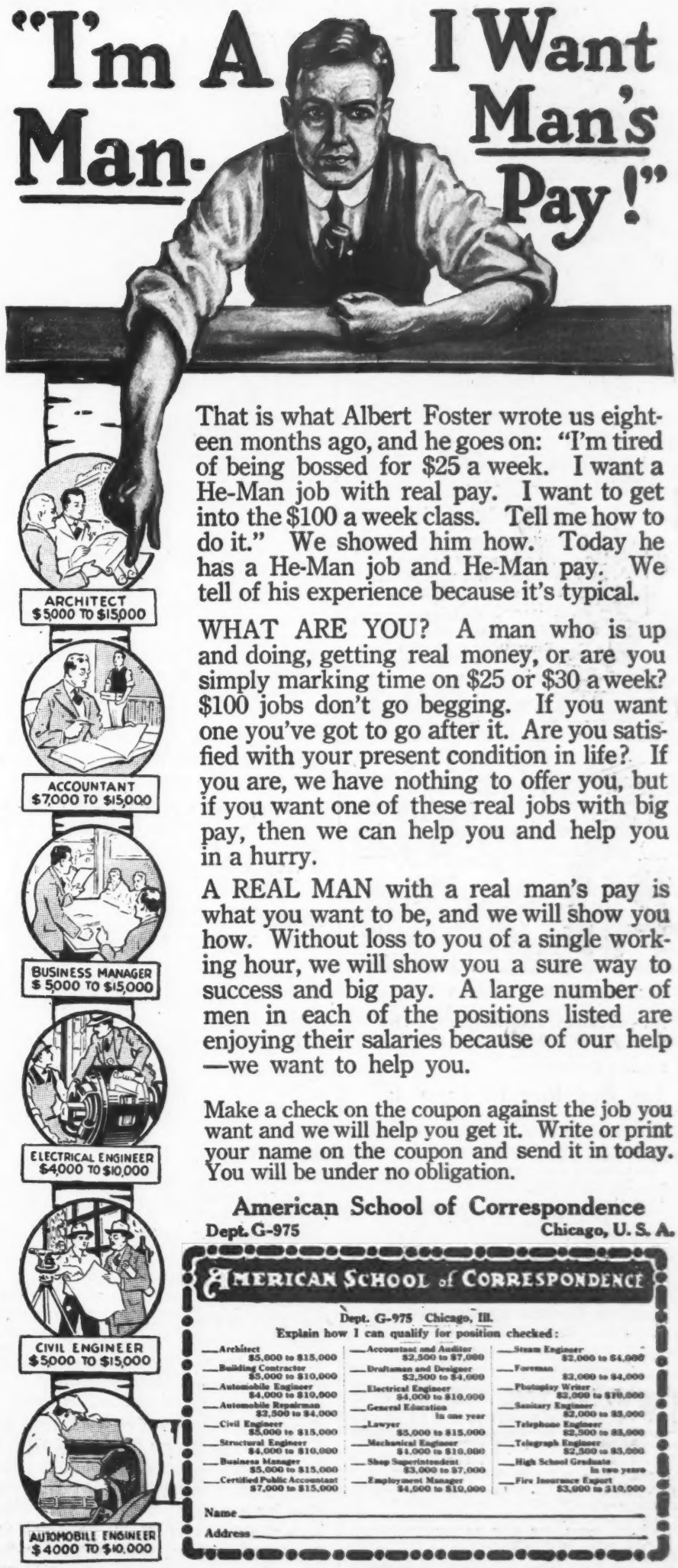
the running-board of the automobile to hold the tires. The illustration shows a few suggestions as to how this may be done.

To make either one of these, use ordinary gas- or water-pipe 1 in. in diameter, with an elbow and long nipple on the one for the spare wheel, and a T and flat-iron bracket with several holes for up-and-down adjustments for the spare-tire bracket. This accommodates tires from 30 in. to 36 in. The difference in size is taken care of by raising or lowering the bracket on the T and replacing the bolt. Secure the tire by a heavy leather strap passed through the ends of the bracket. Fasten the flange to the running-board by bolts.—P. P. AVERY.

Polishing and Weatherproofing Brass Surfaces

FOR quickly scouring and polishing and, at the same time, weatherproofing brass a preparation is recommended, which is composed of three parts of oxalic acid dissolved in forty parts of hot water, to which are added 100 parts of powdered pumice-stone, two parts of oil of turpentine, twelve parts of soft soap, and twelve parts of fat oil. Shake well before using.

"I'm A Man- I Want Man's Pay!"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That is what Albert Foster wrote us eighteen months ago, and he goes on: "I'm tired of being bossed for $25 a week. I want a He-Man job with real pay. I want to get into the $100 a week class. Tell me how to do it." We showed him how. Today he has a He-Man job and He-Man pay. We tell of his experience because it's typical.

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A REAL MAN with a real man's pay is what you want to be, and we will show you how. Without loss to you of a single working hour, we will show you a sure way to success and big pay. A large number of men in each of the positions listed are enjoying their salaries because of our help—we want to help you.

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___Automobile Repairman $2,500 to $4,000	___General Education In one year	___Sanitary Engineer $2,000 to $3,000
___Civil Engineer $5,000 to $15,000	___Lawyer $5,000 to $15,000	___Telephone Engineer $2,500 to $3,000
___Structural Engineer $4,000 to $10,000	___Mechanical Engineer $4,000 to $10,000	___Telegraph Engineer $2,500 to $3,000
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Refinishing Shoe Toes that Are Cracked or Worn

WHEN the "boxed" toes of shoes get scratched or scuffed so that the ordinary polishing will not restore the original appearance, a great improvement can be made by applying shellac.

Rub the shellac on with a rag and rub it off again, so that there will not be a thick coat. If necessary, rub on a second coat when the first is dry. This will not affect future polishings.

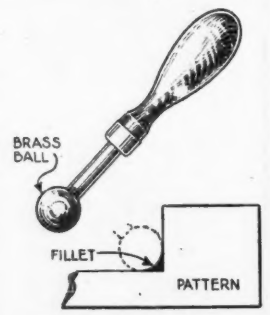
When shining seems to do your shoes no good, perhaps some shellac rubbed into the toes and heels will brighten them up

Shellac cannot be applied where the leather is subject to bending, as it will crack; but on the stiff toes or heels it is very satisfactory.

Brass Tools for the Making of Fillets

IN making patterns for castings an important point is to make all inside angles rounded or "filleted" in order to avoid the tendency to start a break at a sharp angle.

An excellent way to make these fillets is to use a mixture of putty and shellac pressed into the corners and smoothed off to the required radius.



The filleting mixture is pressed into the corners of the pattern by this instrument

This is a sticky mixture, and about the only kind of tool that will work with it is one of polished brass. The end of the tool should be spherical. Good tools can be made for this purpose by mounting polished brass balls, such as are made for valve seats and the like, on steel rods with handles. The diameter of the ball will determine the radius of the fillet.

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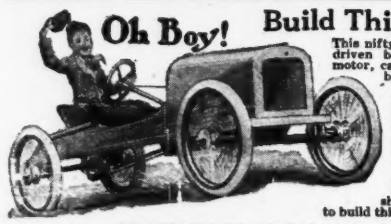

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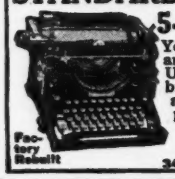

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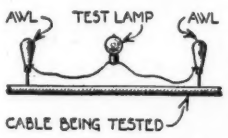
Discovering Worn Insulation in Automobile Wiring

THERE are some very simple devices that one may make at home that greatly simplify the locating of short circuits, open circuits, "grounds" in the various wires on the automobile. The device herewith consists of a pair of ordinary awls, a wire loop, and a test lamp.

The object in view is to bridge over the imperfect electrical circuits and in this way locate them. Each of these awls are to be connected to the



Short circuits and other electrical troubles can easily be located with this testing device

wire with a lamp, as shown, that will indicate whether the circuit is broken or complete. The points of the awls are to be inserted through the insulation of the wires under test.

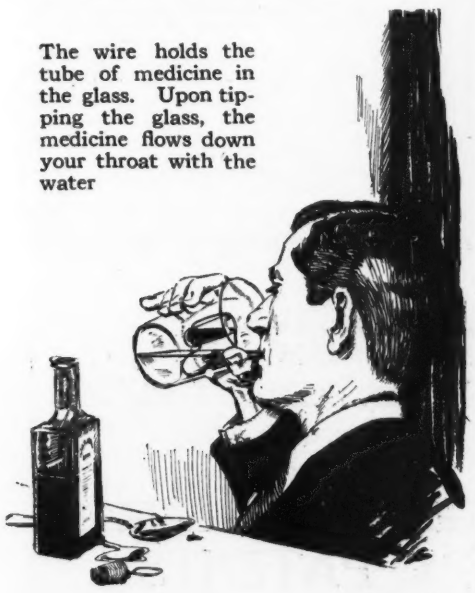
It should be remembered that in the testing of wires where there is no current in them it will be necessary to provide some means of supplying current, and batteries connected to this device serve to accomplish the end in view.—RONALD L. PRINDLE.

An Easy Way to Take Bitter Medicine

MEDICINE that is disagreeable to take can be swallowed with a minimum of unpleasantness by using the simple apparatus shown in the accompanying illustration.

A piece of glass tubing, corked at

The wire holds the tube of medicine in the glass. Upon tipping the glass, the medicine flows down your throat with the water



one end, is suspended by a wire in an ordinary glass. Water is placed in the glass and the medicine in the tube. Then the patient drinks the water, and the medicine pours into it as it goes down, and is hardly tasted.

Any clean wire may be used for the purpose, but for sanitary reasons it is preferable to use silver or nickel wire, which resists corrosion.

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..Thinness	..Poor Memory	..Blackheads
..Rupture	..Rheumatism	..Round Shoulder
..Lumbago	..Gastritis	..Lung Troubles
..Neuritis	..Heart Weakness	..Female Disorder
..Neuralgia	..Poor Circulation	..Weak Back
..Flat Chest	..Increased Height	..Muscular Development
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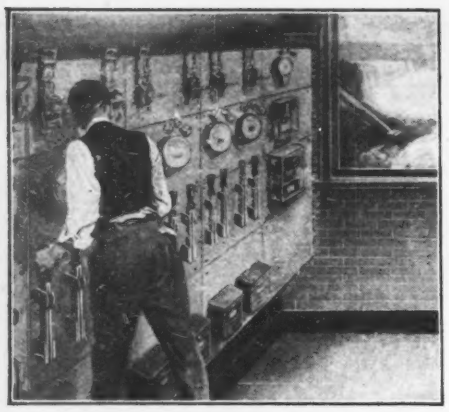

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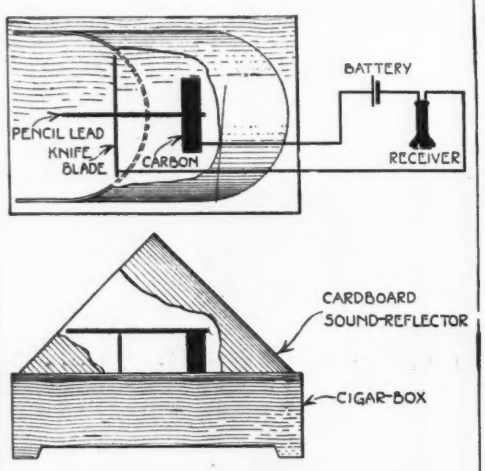
The Microphone Will Enable You to Hear a Fly Walk

WITH a tramp, tramp, like the footfalls of a regiment of soldiers, a fly goes walking along; with a roar like the shouting of some mighty giant, the faint murmur of a human voice is reproduced; far away from the scene a person listens to the plans of a secret conference.

These things and more may be accomplished by the use of the microphone, that instrument which was so useful during the war in detecting enemy submarines, in discovering raiding parties and in revealing secret mining enterprises of the enemy in No-Man's land.

Contrary to what might be supposed, it is very easy to make, and if there is access to a wireless or telephone receiver, the cost is little or nothing. From much experimenting with microphones of all kinds I have found that the instrument described in the following paragraphs is one of the best, both for simplicity of construction and effectiveness.



If you have a telephone receiver you can easily make a sound magnifier with a few odds and ends

The only materials needed besides a receiver are a cigar-box, a piece of pliable cardboard, an electric-light or battery carbon, the lead from a pencil, and the blade of an old knife (the blade from an old case-knife will do very well).

The first thing to do is to procure a large and deep cigar-box and remove a thin piece all around the top of the box, with the exception of a piece at each of the corners which are to be used as legs. Then turn the box upside down and make a groove in the top so as to fit and glue in the knife-blade. A few inches from this place the electric-light or battery carbon.

Next cut the cardboard and glue it to the cigar-box. This acts as a sound-reflector while the cigar-box turned upside down acts as a sounding-board.

The microphone is now practically finished. All that remains are the connections, which are very simple and can be easily made as shown in the upper illustration. When everything is properly connected, put the receiver

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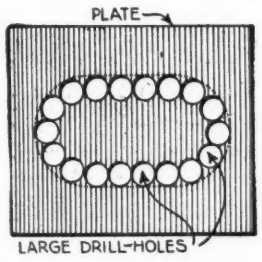
to the ear and complete the circuit by balancing the pencil lead (really graphite, a form of carbon) upon the blade so that it barely touches the piece of carbon. The more lightly it touches the carbon the better. In this instrument a very delicate contact can be made by simply regulating the balance of the lead on the knife-blade.

Upon tapping the box or speaking there will be heard in the receiver a replica of the same sound magnified many times. By the exercise of a little ingenuity the wonderful results described in the first paragraph and countless others besides may be obtained.—FOSTER YORKE.

Cutting Large Holes in Metal Plates

TIME can be saved when large holes have to be cut in metal plates by using a very large drill. The usual method of drilling a large number of small holes along the outline and then cutting away with a chisel entails

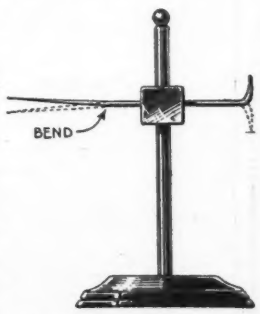


A hacksaw and large drill will soon cut a large hole in a metal plate

the loss of too much time in the drilling. Use as large a drill as possible and when the drilling is finished cut away with the hacksaw. If this is done with a reasonable amount of care, the hole will be clean enough for all ordinary purposes, and it can be smoothed and trued up with a file.

Do You Know this Surface-Gage Wrinkle?

AN exceedingly fine adjustment is often required in working with a surface gage, and it is not always easy to obtain just the right setting in the usual way. There is a very simple method, however, that is as satisfactory as it is easy.



A slight bend in the scriber as shown will allow the mechanic to make a fine change of adjustment

The scriber is slightly bent. It is clamped in place without too much pressure, and by grasping the right-angle end it can be turned a little, altering its position slightly. It will be found that the finest kind of a change can be made in this way. Of course the greater the bend in the scriber, the greater will be the move-

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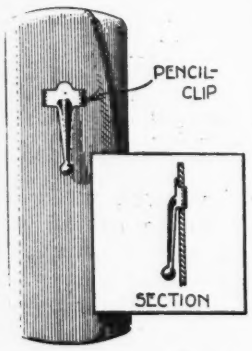
ment when it is turned, so the mechanic must govern himself accordingly.

Ordinarily only a very slight bend should be made.

A Safety Clip for Your Spectacle-Case

HOW many times have you carried your spectacle-case in an outside pocket, only to have it fall out and break the glasses when you bent over? This is a very costly habit and one that can easily be avoided if you will adopt the following idea:



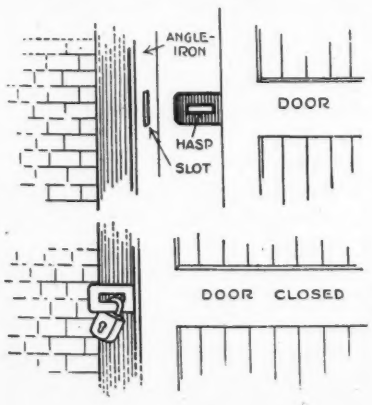
Attach an ordinary pencil-cllp to your spectacle-case and prevent it from dropping out of your pocket

Obtain a pencil clip, one of the ordinary kind will do, and flatten it out with a hammer. Then bend the two edges inward and drive these two ends through the cover of your spectacle-case, clamping the two ends as soon as they are inside the case. With this little device the case can be slipped into any pocket and clamped tightly by the clip. Best of all, it won't drop out and cost you good money for new glasses.—J. W. MOORE.

A Novel Way of Locking a Garage Door

A LOCAL automobile dealer utilized the angle-iron on the edge of his garage door to form part of the locking arrangement.

The hasp was fastened on the inside



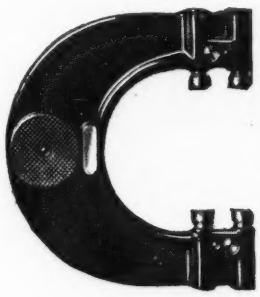
Push the hasp through a slot in the angle-iron from the inside of the door and make the locking arrangement much stronger

of the door and in locking was pushed through a slot in the angle-iron. The padlock was then secured as shown in the illustration. Of course, this method can be applied only to sliding doors of the type most in use at the present time.—JAMES M. KANE.

Making It Easy to Work with Limit Gages

WHEN using the gage shown in the illustration, the mechanic need not know the dimensions to which he is working, and often does not. He is told to make his work sufficiently small to pass one of the limits and too large to pass the other. He may not care what the real value of the dimensions is, and yet the system of gaging has proved remarkably accurate and resulted in greater speed of production than when the attempt is made to work to a single known dimension.

This is not strange when we consider that no measurement can be absolutely correct. The best that can be said of any measurement is that it is a close approximation. Even if a piece of work were absolutely correct one



The machinist is told to make his work sufficiently small to pass one limit of this gage and too large to pass the other limit

moment, the changes of temperature would cause variations very shortly. Besides, obtaining a correct measurement costs time and money. It can not be done in a few seconds, even approximately. Therefore why attempt the impossible?

That is about the conclusion which has forced itself upon the minds of scientific men. Experts are required to make expert measurements, and hence it has been found more profitable to have the experts set the gages than to leave such work to new and perhaps inexperienced hands.—H. C. RIDGELY.

Don't Perfume Your Artificial Ivory

LADIES are attracted to the beautiful imitation ivory toiletware now sold extensively for toilet-table accessories.

Unfortunately, perfumes have their place also on toilet-tables. Perfumes contain a high percentage of alcohol. In order to avoid mental anguish over the marring of her beautiful hairbrushes, mirror-backs, combs, hair-receivers, and so on, she should understand that alcohol is destructive to the surface of her "ivory" toiletware.

Imitation ivory is a product of cotton. It is a pyroxylin plastic and is attacked by alcohol.

There is a cleaning cream on the market especially intended to be used on artificial ivory. It will remove slight scratches and stains and restore the luster of dulled surfaces, but perfume is apt to permanently discolor the articles and forever ruin their beauty.

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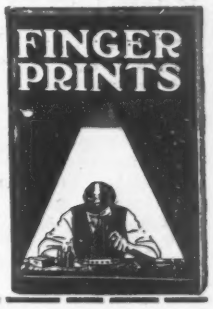

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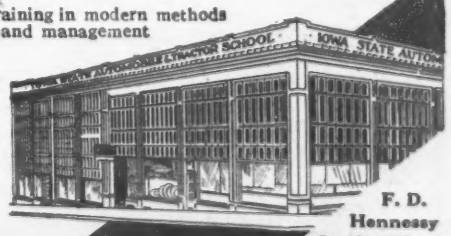

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Have You a Step-Saving House?

The Popular Science Monthly will pay ninety dollars for the best answers

HOW do you save steps in your home? What arrangements or what appliances have you made that save time and reduce work that would otherwise have to be done by hand?

The Popular Science Monthly wants to know just what practical and useful things can be constructed to make every house a step-saving house. For instance: a concealed laundry chute would interest us, if it weren't so old; a space-saving cupboard—another old one. No patented or marketed appliances will be considered.

The Popular Science Monthly offers three cash prizes—a first prize of $50, a second prize of $25, and a third prize of $15—to be awarded in accordance with the rules set forth below.

Rules Governing the Contest

(1) Contestants are not limited to the number of step-savers and time-savers, but only one method can possibly win the first prize, only one the second, and only one the third. The contest is open to everybody.

(2) The method must be shown clearly either in a photograph or in a drawing. If a drawing is sent in, it need not be made by a skilled draftsman. It is sufficient that it should be intelligible. While pencil sketches will be considered, contestants are requested to make their drawings in ink on heavy white paper. The views should be sufficient in number to set forth the writer's idea very clearly. The contestant's name and address should appear on each sheet of drawings.

(3) The drawings or photographs must be accompanied by a description, preferably typewritten, in which the method is clearly given. It must be written on one side of the paper only, and it should not be more than 500 words in length. The name and address of the contestant should appear in the upper left-hand corner of the first sheet of the written description.

(4) The drawings and description entered by contestants must be received by the Popular Science Monthly not later than 5 p. m. on Friday, December 31, 1920.

(5) The judges of the contest will be the editors of the Popular Science Monthly.

(6) The first prize of $50 will be awarded to the contestant who, in the opinion of the judges, has suggested the best method for saving steps in the house.

The second prize of $25 will be paid to the contestant who submits a method next in merit.

The third prize of $15 will be paid to the contestant who submits the method third in merit.

(7) The winners of the contest will be announced in the earliest possible issue of the Popular Science Monthly. A description of the methods which win the three prizes offered will duly appear in the pages of the Popular Science Monthly, together with the names of the winners.

(8) The editors of the Popular Science Monthly shall have the right to publish meritorious manuscripts which do not win a prize. The regular space rates will be paid to the contestants who submit the manuscripts thus selected.

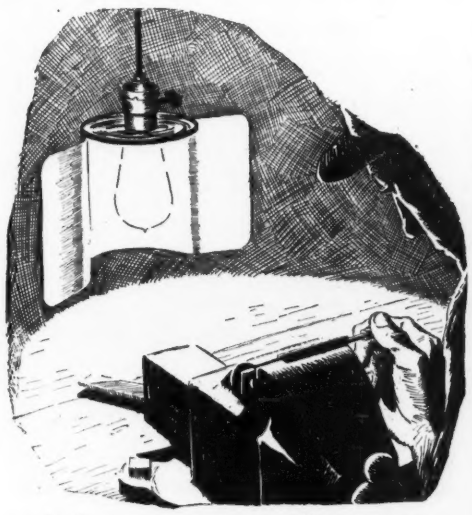
(9) When a contestant submits more than one method, the description and drawing by which each is set forth must be sent as a separate unit.

(10) Manuscripts or drawings will be returned to contestants if stamps are enclosed.

(11) Send drawings and specifications to the Editor of the Step-Saving House, Popular Science Monthly, 225 West 39th Street, New York City.

A Light-Reflector from a Tin Can

WHEN a reflector is wanted in a hurry for use with an incandescent light, one that will serve the purpose very well can be made from an old tomato can. In fact, the result is rather surprisingly good if the can is bright and clean inside. Simply split

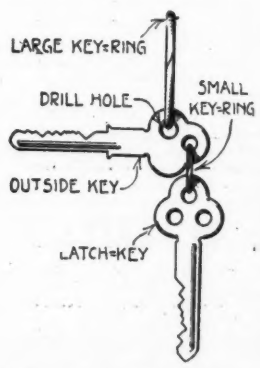


A tin can makes an excellent reflector. The can is simply split open and turned back

the can down one side, cut out one end, and in the other end make a hole into which the lamp socket will fit tightly. Turn back two wings from the split. Set them at the angle that seems to throw the light best. That is all there is to it. The illustration shows the idea quite clearly.

Finding the Right Key Made Easy

SOME time ago I was put to the daily necessity of using two latch keys to reach and enter my room. It happened that there was no light near either door, and as there was but little difference in the keys it was very annoying at times to find after infinite trouble that the wrong key had been inserted in the fugitive keyhole. To overcome this trouble I drilled a 3/16-in. hole in the upper side of the key to the outside door, the side by which it was attached to the key ring. To the regular hole in this key I fastened the inside door key by a small link.



Here is a way to arrange a bunch of keys so that the one you use the most will automatically present itself to your searching fingers whenever you pull your keys out of your pocket

Then I had but to take the bunch of keys from my pocket and the proper latch key automatically presented itself.—J. J. LANKES.

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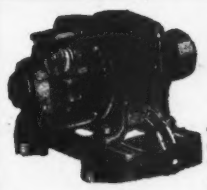

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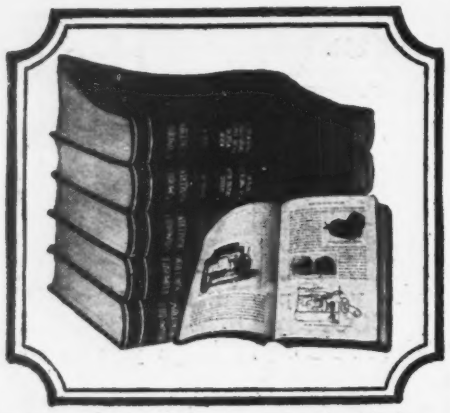

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How and When to Cut Your Canary's Claws

IF the cage of a canary is supplied with thin resting-sticks, the birds will often develop various infections of the foot. Such sticks do not give the bird a safe resting-place. They should be removed and replaced by larger, oval, not rounded, twigs which the bird cannot encircle with its claws.

The claws often grow abnormally long and hooked, then the birds become entangled in the wire mesh of the cage and do themselves injury. Splintered claws are also often met with;

A canary's claws must be manicured as well as your own finger-nails. Here is the right way to do it and keep your bird healthy

these, when they break off close to the flesh, cause wounds and swellings. Other claws bend and grow backward so as to enter the flesh. This causes infections. Under all these circumstances the claws must be cut back.

Take the bird in your left hand so that it lies on its back. Encircle the neck with thumb and forefinger. Gently lift the foot, being careful not to touch the nails. Hold against the light. Cut the nails with a sharp pair of shears where they are still opaque and just below the transparent section which is filled with blood. When held in such a position the transparent section of the claw can be easily recognized.—ERNEST BADE.

A Circular-Saw Attachment to Hasten Production

A STOCK authorization order called for about 1000 whitewood boards from 6 to 10 in. wide and about 2 ft. long, but only ¼ in. thick. These boards had to have a ⅛-in. slot all the way around the edge and be about ¼ in. deep.

At first it was a problem, as many of the boards were green or warped, and many, as the slot was cut, had a tendency to curve a trifle and break off or cut through the remaining 1/16-in. side wall. Many times I nearly cut my finger until I devised a scheme to hold and feed the boards to the saw.

A piece of ¾-in. pine about 6 in.

U.S. PATENTS

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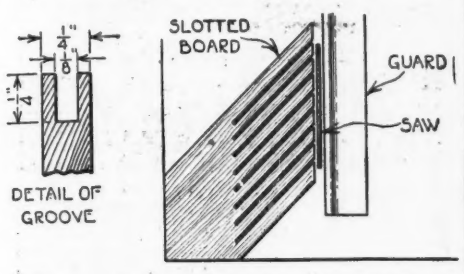

Rig up a fingered guide-board like this to protect your fingers from the circular saw

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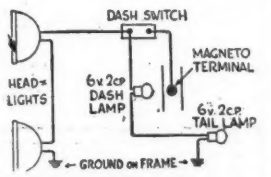

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Be careful, when grinding the file, that you do not burn it and thereby lose the temper. After it has been ground, sharpen the surfaces on an oilstone much as you would the knife of a plane, but giving the file an up-and-down motion at the same time you are giving it the back-and-forth movement; so that the entire surface is sharpened in one operation. Be sure

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Cuts True
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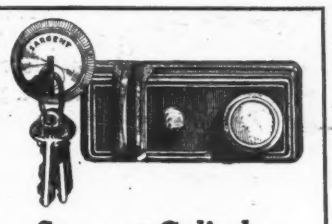

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How and When to Cut Your Canary's Claws

IF the cage of a canary is supplied with thin resting-sticks, the birds will often develop various infections of the foot. Such sticks do not give the bird a safe resting-place. They should be removed and replaced by larger, oval, not rounded, twigs which the bird cannot encircle with its claws.

The claws often grow abnormally long and hooked, then the birds become entangled in the wire mesh of the cage and do themselves injury. Splintered claws are also often met with;

A canary's claws must be manicured as well as your own finger-nails. Here is the right way to do it and keep your bird healthy

these, when they break off close to the flesh, cause wounds and swellings. Other claws bend and grow backward so as to enter the flesh. This causes infections. Under all these circumstances the claws must be cut back.

Take the bird in your left hand so that it lies on its back. Encircle the neck with thumb and forefinger. Gently lift the foot, being careful not to touch the nails. Hold against the light. Cut the nails with a sharp pair of shears where they are still opaque and just below the transparent section which is filled with blood. When held in such a position the transparent section of the claw can be easily recognized.—ERNEST BADE.

A Circular-Saw Attachment to Hasten Production

A STOCK authorization order called for about 1000 whitewood boards from 6 to 10 in. wide and about 2 ft. long, but only ¼ in. thick. These boards had to have a ⅛-in. slot all the way around the edge and be about ¼ in. deep.

At first it was a problem, as many of the boards were green or warped, and many, as the slot was cut, had a tendency to curve a trifle and break off or cut through the remaining 1/16-in. side wall. Many times I nearly cut my finger until I devised a scheme to hold and feed the boards to the saw.

A piece of ¾-in. pine about 6 in.

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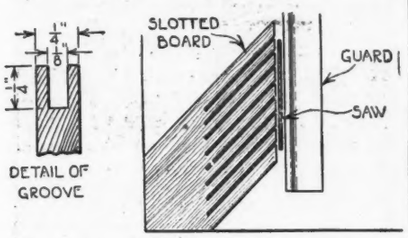

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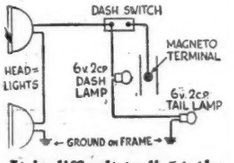

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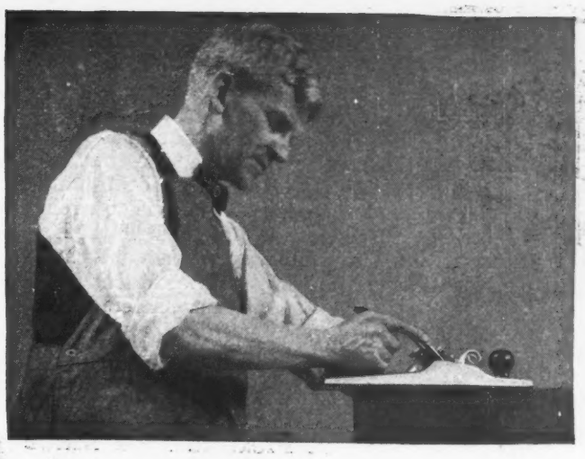

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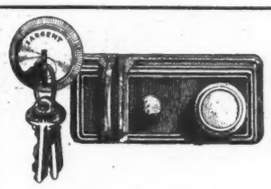

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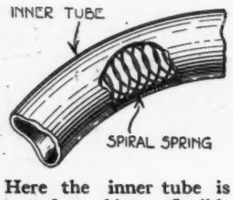
to have the three edges and the point sharp before attempting to drill a hole. Place the drill in the brace and moisten the surface of the glass that is to be drilled, with a little kerosene or turpentine. The author has found turpentine to give the best results. Always keep the drill wet with turpentine or kerosene to avoid chipping of the glass. Drill the hole half way through the glass and then commence on the opposite side. This will overcome chipping and cracking if you are to go entirely through the glass. Sharpen the drill frequently.—PAUL J. KORDES.

A Flexible Pipe Made of Inner Tube

A FLEXIBLE tube or hose for conducting water can be made of an inner tube with the aid of a piece of spring wire wound into a spiral.

Wind the wire about a spindle a trifle larger than the inside of the tube. It should take the form of a large spiral spring. Then force it into the inner tube by screwing exactly as you would a screw.



Here the inner tube is transformed into a flexible pipe with a piece of spring wire

Such a pipe can be used for conducting water or air where very little pressure is generated. If much pressure is exerted in the pipe, it can be kept from expanding by winding a second coil outside. By wrapping the outside with tire tape, the same strengthening effect can be produced.

The Most Efficient Part of an Automobile

THERE are hundreds of moving parts on an automobile or motor-truck, but none works so hard and so efficiently as a universal joint. Such a joint is necessary on the propeller shaft extending from the clutch to transmission and from the transmission to the rear axle, as the case may be. Universal joints are known to operate at over 98 per cent efficiency, which cannot be said of any other part of an automobile doing such strenuous work.

The universal joint, as its name indicates, allows for free or universal movement of the propeller shaft. It is like your thumb which you can wiggle in all directions. A universal joint takes the power of the engine and transmits it to the propeller shaft, and at the same time this joint may be constantly moving, first in one direction, then another, but usually it moves up and down because the rear axle keeps moving up and down over the road. The propeller-shaft angularity varies according to the relative movement of the rear axle, and were it not for the use of universal joints, the

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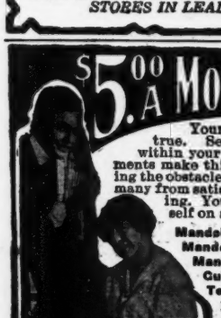

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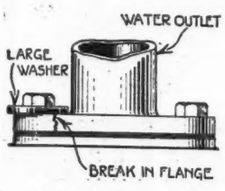
shaft would bend or break and hence could not transmit power.

It is remarkable how this part stands up even when owners forget it. Most owners do not know what a universal joint looks like because it never gives any trouble, but the wise owner will not allow joints to go without grease. Grease is easily injected through the filler opening by means of a suitable grease-gun. The joint should not be filled completely—one third full is sufficient.—H. A. TARANTOUS.

Repairing a Broken Lug with a Washer

AN emergency repair for a lug broken in tightening up an outlet water connection for an automobile, is shown in the accompanying illustration. These connections are usually cast iron, and in putting in the bolts an extra twist will frequently crack them.

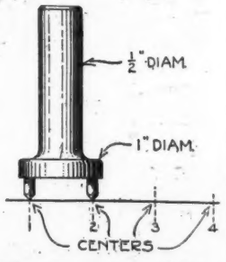


A washer inserted over a broken bolt-hole on a lug will enable you to run the car until the broken part is replaced

The repair was made simply by inserting a large washer under the bolt-head when the gasket was in place, and screwing down solidly. This repair will carry over until a suitable replacement part can be obtained.—GEORGE L. LUERS.

How to Make a Double Center Punch

THE writer had a lot of machine pieces given him to center punch. The holes were all the same distance apart, so to save laying them all out, and probably making them inaccurately, he invented the double punch shown in the illustration. With it, all that was necessary was to lay out the first hole on the piece of metal. Setting the punch in hole No. 1, a blow was struck which made holes at No. 1 and 2. The punch was then set in No. 2 hole and another blow struck which made No. 3 hole the correct distance away from No. 2. The procedure was repeated until all the holes were made. Considerable time was saved by adopting this scheme.



The two points of this center punch make even spacing of a row of punch marks possible

This double center punch will be found advantageous when it is necessary to make evenly spaced punch-marks for drilling rivet-holes in boiler-plate.—J. W. MOORE.

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Does Work of 10 to 15 Men!

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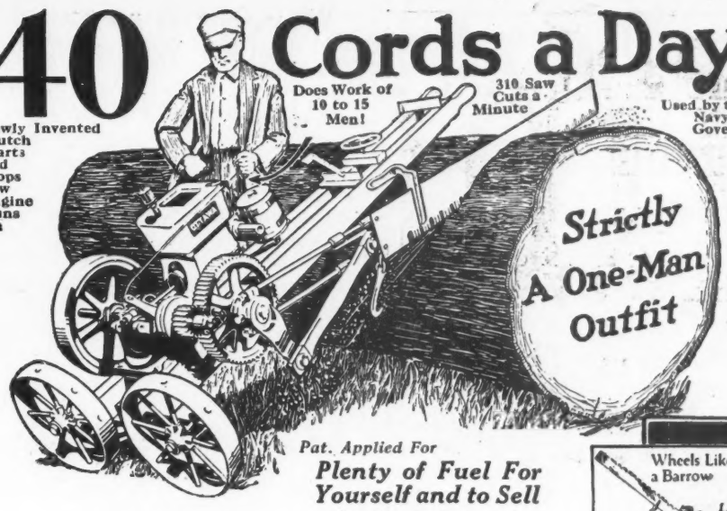

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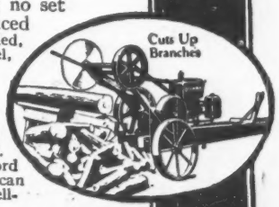

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Your machine is *human* in the manner that it depends on human skill and attention to get the production that is in it.

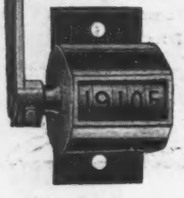
Though the quality of its construction be the best, the quantity of its *production* varies with the skill and industry of its operator.

This efficiency of the *human* factor is what you want to check up with a

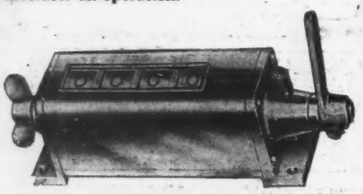
Veeder COUNTER

—for it decides whether you're getting out of your machine a *full return* for the money and brains put into it.

The small Revolution Counter below registers one for a revolution of a shaft, recording a machine operation, or product. Though small, this counter is very durable; its mechanism will stand a very high rate of speed, making it especially suitable for light, fast-running machines, and most adaptable to experimental work. If run backward, the counter subtracts. Price $2.00. (*Cut nearly full size.*)



The Set-Back Rotary Ratchet Counter below is for the larger machines, such as punch presses and metal-stamping machines, where a *reciprocating* movement indicates an operation.



Registers one for each throw of the lever, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $11.50—subject to discount. (*Cut less than ½ size.*)

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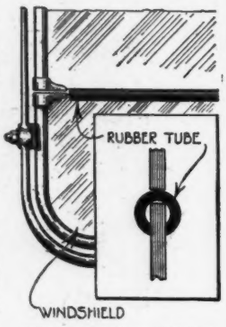
When the Wind-Shield Rubber Wears Off

WHEN the rubber on the wind-shield wears off or is lost, you will find it very convenient to replace it with a piece of rubber tubing about ⅜ in. in diameter with as heavy a wall as you can purchase. As shown in the illustration, it will be necessary to cut it down the length of the tube to open it.

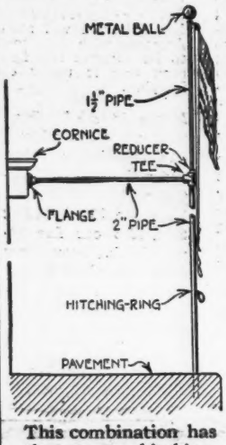


Heavy rubber tubing will replace worn wind-shield rubber

It is very easily attached and taken off, and helps to eliminate the vibration of the glass, also keeping out the rain better. If it is to be used to eliminate vibration, it will be necessary only to place two 3-in. pieces on each end of the glass.—H. E. MENDE.

Combining a Flagpole with an Advertising Sign

A PATRIOTIC and ingenious merchant decided to make the flagpole in front of his establishment serve a triple purpose. The pole was a length of iron pipe that ran down into the cement walk which served to hold it securely. The merchant cut this pole in half with a hacksaw, threaded the cut portions, and screwed on a pipe-T. He then ran the upper part of the pole across to the store and fastened it with a flange. A smaller diameter pipe was then set in the upper part of the flagpole and the result was a support for hanging an advertising sign, a more solid flagpole and, with the addition of a ring attached to the lower part of the pole, a hitching-place for horses.—JAMES M. KANE.



This combination has three uses, a hitching-post, an advertising medium, and a flagpole

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I HAD occasion to scrape the carbon out of my automobile cylinders recently, and discovered a way to speed up a tiresome piece of work.

I connected a vacuum cleaner to one of the sockets in the garage, bent a piece of 1-in. pipe at an angle of about thirty degrees, and inserted the pipe in one of the valve-caps while I

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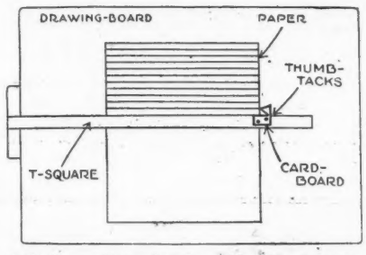
scraped through the other. The pipe connected to the vacuum hose carried away the loose carbon as fast as it was removed with the scraper.

I found that this method enabled me to do the work much more rapidly. It has a second advantage in that it leaves the combustion chamber absolutely clean, and there is no danger of leaving a deposit of carbon or dirt to score the cylinders.—F. G. J.

To Evenly Space and Ink Lines in a Hurry

WHERE the mechanical draftsman has been given a job which necessitates ruling many evenly spaced lines in a hurry, the little cardboard



A little cardboard pointer attached to the T-square will enable you to draw evenly spaced lines quickly

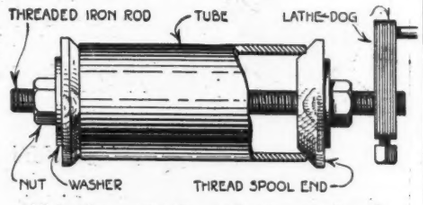
attachment shown in the illustration will be found to expedite the work.

First cut a piece of cardboard the shape shown and attach it to the end of the T-square with thumbtacks. By setting the pointer against the line already drawn and moving it down after each line is drawn, the lines will be found to be perfectly spaced.

Adjustable Centers for Small Lathe-Work

THE most difficult thing to finish in the lathe is a tube. To do the work right, a mandrel should be fitted, but this takes time and the mandrel costs more than the job is worth in the end.

The writer has found that it pays to keep a goodly supply of thread-



This shows the jig with the spool ends with a tube in place

spools on hand. The ends of these spools are cut taper, and by sawing off the ends and slipping them over a round iron rod, an adjustable arbor or mandrel is obtained which can be used for tubing from ½ to 1 in. in diameter. The holes are always centered with the taper and the tube finds its own center as soon as it is clamped into place.

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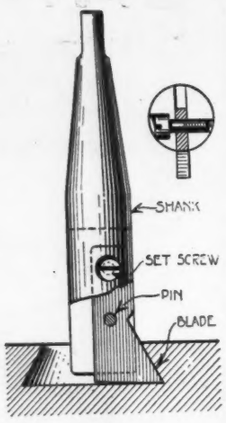
The Best Way to Drill a Triangular Hole

CAN you drill a hole larger at the bottom than at the top? In answer to this question we say "Yes," provided you use the ingenious device illustrated here.

The shank of the tool has a slot cut in it to which is attached a slanting blade. This blade is about 1/8 in. thick and is pivoted with a pin to the shank of the tool.

You can swivel this cutter, or blade, to any desired angle you wish, then having obtained the desired angle, you fasten the cutter in its correct position by the set screw.—J. W. MOORE.

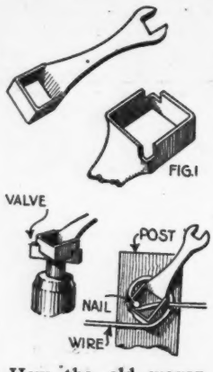


Cutting a hole larger at the bottom than at the top sounds impossible Here is the way it is done

Increasing the Usefulness of a Wagon Wrench

BEFORE the advent of the automobile this type of wrench was very common. It fitted two sizes of nuts, and there its use ended.

I find that a few cuts of a hacksaw will extend its sphere of usefulness. Two sections are cut out of the end, as in Fig. 1. One can be cut a trifle smaller than the other, in which case small nuts of two sizes can be handled. Fashioned in this way it can also be used to turn a T-headed valve key.



How the old wagon wrench can be brought up to date again

When pivoted upon a stout nail it will act as an emergency wire stretcher.

It can be used as well for making a uniform kink in wire, so as to take up the slack.—JAMES M. KANE.

A Copying Idea for the Photographer

HAVING a 5-by-7 camera and desiring to make full-sized copies of a batch of old 5-by-7 prints, nothing seemed easier than to set up and shoot. But right then my troubles started—the camera was fitted with

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a lens of 8½-in. focal length, while the bellows extension was only 12 in.

Now, it is one of the fundamentals of photography that, in order to obtain a full-sized image of an object, the lens must be placed twice its focal length from the plate. As twice 8½ is 17, I was some 5 in. on the minus side.

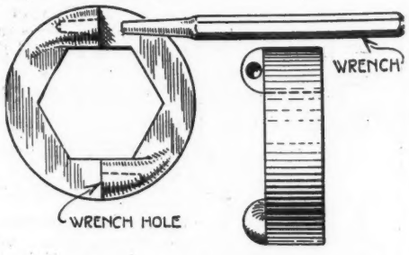
For a while it looked as if I would have to be satisfied with smaller copies or else build a 5-in. extension on my lens mount, when the great idea broke and saved the day. I borrowed a lens of 5¾, mounted it on a spare lens board, and the rest was mere routine work.

While the 5¾-in. lens would not have covered a 5-by-7 plate at the ordinary extensions used in landscape work, it gave even illumination to the corners (and probably beyond) when drawn out to a distance of 11½ in.—FRANCIS M. WESTON, JR.

A Way to Remove Stubborn Nuts Quickly

WHEN a nut becomes rusted, it is a very difficult job getting it off the bolt or stud on which it is set. To use a hammer and chisel usually results in the nut being made worthless.

Being up against such a proposition and wishing to save the nut, which was a special thread, we made a novel



A few blows with a hammer on this type of wrench will remove the most stubborn nut

wrench as shown in the illustration. The hexagonal part of the wrench was set over the nut and a few good blows with a hammer given it. Off came the nut. So good was this idea that we adopted this style wrench for all such jobs.—J. W. MOORE.

How Street Curbing Injures the Tires

THERE is one bit of carelessness of which nearly all motorists are guilty at times, and which, unfortunately, is almost a habit with many. That is the practice of driving the tires against street curbs—most commonly in backing the car—so that the side walls and the fabric are bent.

It pays to avoid these little bumps carefully as one of them may easily weaken the fabric to such an extent that a blow-out will result.

Don't park the car so that the front wheel is snugly jammed against the curb, because when you are ready to leave you may find it impossible to

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1500 GOOD TOOLS

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No. 125

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WORK out your ideas on this practical little lathe. It will handle a wide range of work. In fact, with its many possible attachments it gives you almost a complete shop in your own home or laboratory.

It will take work up to 12 inches in length, with a swing of 7 inches. It is furnished with an adjustable Tee Rest, a Slotted Face Plate, a Saw Arbor and a Drill Chuck of 0 to ¼-inch capacity, with a No. 1 Morse Taper Shank. The Tail Stock has both lever and screw feeds.

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Makers of Mr. Punch

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What does He want for Christmas?

Now is the time to be thinking of those little gifts which make Christmas a day of gladness and good-will.

For a useful gift to the mechanic or the technical student home for the holidays what could be more appropriate than a good tool?

Your dealer carries Brown & Sharpe Tools. Ask to see the line of Micrometer Calipers in Morocco Gift Cases. Note the fine finish and remember that seventy years' experience guarantees their accuracy.

If your dealer cannot supply you, we'll be glad to send Catalog No. 28

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By THOMAS STANLEY CURTIS. 69 pp., illus. Price, 50 cents.
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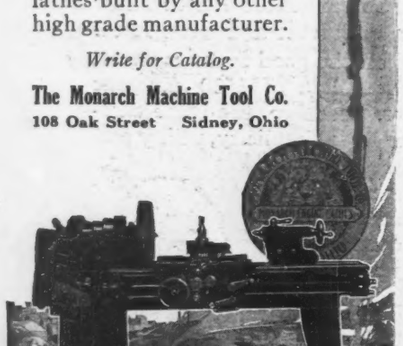

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Statement of the Ownership, Management, Circulation, etc., required by the Act of Congress of August 24, 1912, of Popular Science Monthly, published monthly at New York, N. Y., for October 1, 1920. State of New York, County of New York, ss. Before me, a notary public, in and for the State and county aforesaid, personally appeared O. B. Capen, who, having been duly sworn according to law, deposes and says that he is the Business Manager of the Popular Science Monthly and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, The Modern Publishing Company, Inc., 225 West Thirty-ninth Street, New York, N. Y. Editor, Waldemar Kaempffert, 225 West Thirty-ninth Street, New York, N. Y. Managing Editor, Waldemar Kaempffert, 225 West Thirty-ninth Street, New York, N. Y. Business Manager, O. B. Capen, 225 West Thirty-ninth Street, New York, N. Y. 2.—That the owners are: The Popular Science Publishing Company, Inc., 225 West Thirty-ninth Street, New York, N. Y. Stockholders of Popular Science Publishing Company, Inc., Henry J. Fisher, 22 William Street, New York, N. Y.; Oliver B. Capen, 225 West Thirty-ninth Street, New York, N. Y.; Robert Cade Wilson, 683 Springfield Avenue, Summit, N. J.; Waldemar Kaempffert, 225 West Thirty-ninth Street, New York, N. Y.; George B. Agnew, 22 William Street, New York, N. Y.; Susan D. Bliss, 22 William Street, New York, N. Y. 3.—That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent. or more of total amount of bonds, mortgages, or other securities are: Importers and Traders National Bank, 247 Broadway, New York, N. Y.; H. J. Fisher, 22 William Street, New York, N. Y. 4.—That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

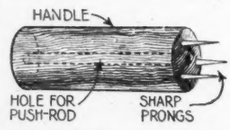
(Signed) O. B. CAPEN, *Business Manager.*

Sworn to and subscribed before me this 17th day of September, 1920.
Arthur A. Blauvelt, Queens County—2767, New York County—639, New York Reg. 1612.
(Seal.) My commission expires March 30, 1921.

turn the wheels away from it. If you do find yourself in this predicament, and all efforts to turn the wheels sufficiently to effect a getaway prove of no avail, put the jack under the center of the front axle and raise it a few inches. Then push the car away from the curb and off the jack. The slight drop won't hurt the car and it will get the inside wheel far enough away from the curb to make it possible to maneuver your way clear.

A Holder for Varnishing Casting Patterns

PATTERNS for castings are varnished all over with shellac varnish. The parts that are to be reproduced in metal are finished with black shellac and the coreprints, which make the recesses in which the cores are placed, are finished in orange shellac.



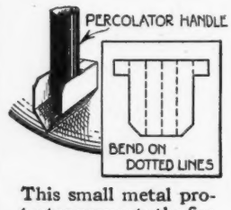
Three sharp prongs slip into the pattern and hold it until the varnish is applied

In order to hold the pattern while applying the varnish the tool here shown is very convenient. It is simply a handle with three thin, sharp prongs that are thrust into the wood just enough to give a hold. When the work is finished, a rod is thrust through a hole running the length of the handle and the pattern is pushed from the holder.

To Protect the Handle of Your Percolator

THE wooden handle on your coffee percolator can easily be protected from burning off at the bottom by attaching this small protector, which deflects the heat from the bottom of the handle.

A small piece of aluminum, brass, or copper will answer the purpose if bent into the shape shown in the illustration. It is attached to the handle by bending the outer flaps over the top of the lower handle and braced securely.



This small metal protector prevents the fire from burning the percolator handle

This was found to be very efficient, and if the same is done to your percolator, it will prolong its life considerably.—H. E. MENDE.

What the Small Vise Will Do

NO owner who does any repairing or tinkering with his car should be without a small vise. Next to such indispensable tools as screwdriver, wrenches, and pliers comes a small

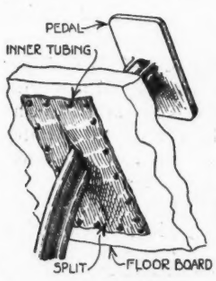
metal vise. You can buy such a tool as we have in mind for very little money. Get one that has a spread of 3 or 4 in., and you will wonder how you ever got along without it. This size is better than a larger one for the reason that for all ordinary work its spread is amply large, and it is much easier to manipulate a small tool of this kind than a large and cumbersome affair.

The big thing about a vise is that it grips—acts like an extra pair of hands when you have more things to hold than you have hands. A small vise also can be used advantageously in place of a pair of pliers for straightening wires, cotter-pins, and similar articles, and it has a great deal more straightening power than can be exerted by hand with the pliers.

For compressing small springs a vise can also be used handily sometimes.

Another Use for the Old Inner Tube

IN the summer hot air is apt to arise from around the pedals of an automobile, and in the winter it it is liable to be decidedly chilly. To be able to exclude these disagreeable gusts of air may not seem easy, but here's the way to do it.



A piece of old inner tube tacked around the pedal prevents hot and cold air from striking your feet

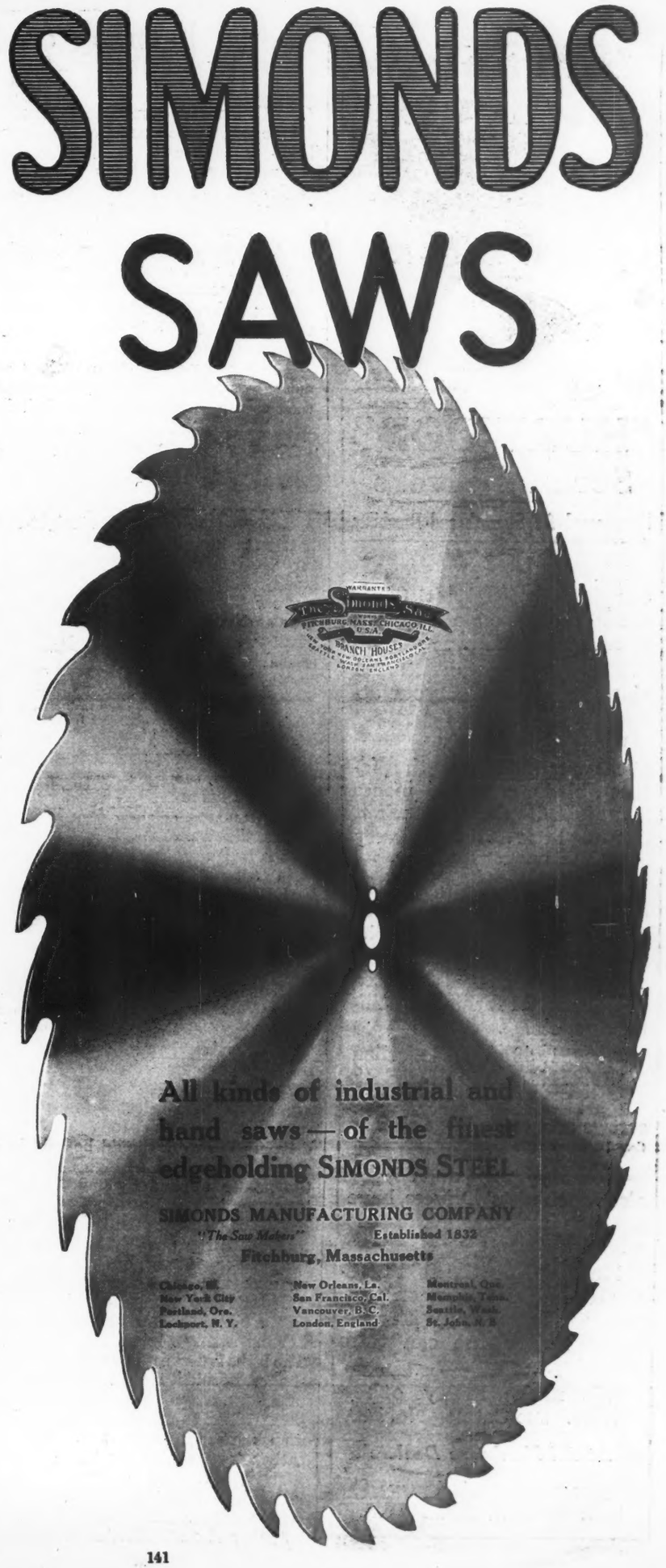
Cut out a section of old inner tube and make a slit down the middle long enough to allow the pedal to be worked its full distance. Slip the slit over the pedal and down the shank and tack it to the under side of the floorboard.

The rubber will always hug the pedal shank close enough to keep out the drafts, and yet will not interfere with the operation of the pedal itself.—WINDSOR CROWELL.

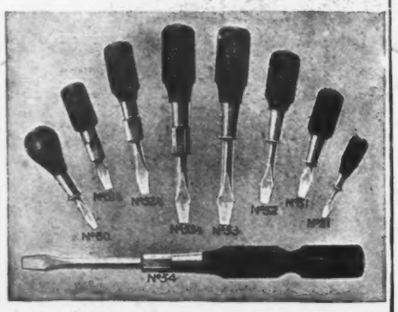
To Select Speedometer Gear Sizes

WHEN you change from normal size to oversize tires, it will be necessary to change the speedometer gear if you want the instrument to read absolutely accurately. The rule to follow is that the number of teeth in the large speedometer gear—the one attached to the road wheel—must be twice the diameter of the tire in inches.

For instance, if your car is equipped with 32 by 3½ in. tires, the speedometer gear should have 64 teeth. But if you put on the oversize tire that fits the same wheel, 33 by 4, the large speedometer gear should be changed to a 66-tooth size.



Stanley Tools



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Also No. 60—shown at the left—only 1⅝ inch blade, but with a big sure grip handle. For heavy work into close corners it cannot be beaten. Used by Plumbers, Machinists, Millwrights, etc.

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Knurling on the Small Lathe

By H. H. Parker

THE amateur sometimes is unable to finish small parts of his home-built apparatus in a workmanlike manner because he lacks the proper equipment to knurl the edges of small adjusting screws and nuts, the handles of tools and other pieces of brass or steel. Satisfactory knurling may be performed with simple apparatus on almost any small speed lathe or screw-cutting lathe, and the knurls themselves are all that it is really necessary to purchase.

These come in a large variety of patterns, straight, angular, and crossed with coarse, medium, and fine pitch, straight, convex, or concave faces, as well as more complicated and fancy patterns. For all-around work the medium-pitch diamond-pattern straight-face knurl is perhaps the best. A concave-face fine-pitch straight-cut pattern is useful for finishing small binding-screw thumb-nuts and similar small work. It should be remembered that the harder the material to be knurled or the coarser the pitch of the knurl, the more power is required and the greater the strain on the lathe.

In regard to holders, the simplest is that shown in Fig. 1, a split or forked end drilled for the knurl-pin and provided with a wooden handle at the other end. Such a holder may be bought or is easily constructed at home and is suitable for a small speed lathe, either foot or power driven. The work should be held in a chuck and driven at high speed and the holder applied by hand, using a T-rest as in wood-turning. The pin should be oiled frequently. By bringing the knurl up under the work with the holder resting on the rest, the necessary leverage may be obtained.

If the lathe is provided with a slide rest, a simple holder, shown in Fig. 2, holding a single knurl, may be made. The lathe is first set in motion and then the cross slide moved up until the knurl presses against the work, care being taken to set the holder at right angles to the lathe-bed. Though satisfactory work may be performed with these holders using one knurl, it can be seen that there is always a certain amount of strain upon the lathe-spindle and cross-slide, since considerable pressure is required, and this will be especially hard upon a small lathe.

A special type of holder containing a swiveling head and two knurls is in the market, and while this would be an improvement for use upon a medium or heavy lathe, the side pressure is still present. The way to overcome this difficulty is to use three (or perhaps two set diametrically) knurls and a self-contained means of applying the pressure, thus balancing the device and removing the strain from the lathe. Many forms have been devised for this purpose and Fig. 3 suggests one that can be built up from bar stock and which has a wide range of adjustment. The pressure is applied to the work by means of the wing-nut and the device is entirely independent of the lathe-carriage. Another way would be to make three adapters to clamp to the jaws of a universal lathe-chuck and hold the chuck in the tailstock by means of a specially made adapter fitting into the tailstock quill; the pressure would then be applied by the regular chuck-key.

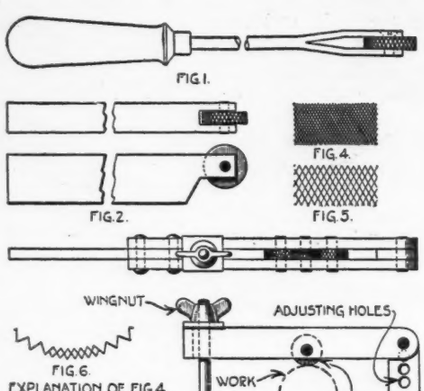

Fig. 1. A hand knurling-tool. Fig. 2. A single knurl tool post-holder. Fig. 3. Adjustable knurl-holder for a lathe. Fig. 4. As work sometimes appears. Fig. 5. As it should appear. Fig. 6. Explanation of Fig. 4

Frequently upon knurling a piece of work, the pitch, instead of appearing like Fig. 5, for instance, matching the knurl, is much finer, something like Fig. 4. This is a puzzling difficulty until we stop to think that knurling is something like cutting a gear—if the gear blank is not turned the proper diameter, the last tooth cut will overrun the first.

This is what happens if the work to be knurled is not the right diameter—the knurl teeth will overrun and form a series of fine pitched teeth. It is, however, not worth while trying to figure out the correct work diameter, for this does not happen very often and when it does, the trouble is usually obviated by taking a light cut over the work to remove the marks; then apply the knurl again as usual.

As knurling increases the diameter of the work over the points of the ridges, it is a means often used to make a pin or bushing fit which was formerly too loose in its hole, and this is often the only way to correct a piece of work turned down too small.

December, 1920

A Startling Memory Feat That You Can Do

How I learned the secret in one evening. It has helped me every day

WHEN my old friend Faulkner invited me to a dinner party at his house, I little thought it would be the direct means of getting me a one-hundred-and-fifty per cent. increase in salary. Yet it was, and here is the way it all came about.

Toward the close of the evening things began to drag a bit, as they often do at parties. Finally some one suggested the old idea of having everyone do a "stunt." Some sang, others forced weird sounds out of the piano, recited, told stories, and so on.

Then it came to MacDonald's turn. He was a quiet sort of a chap, with an air about him that reminded one of the old saying that "still waters run deep." He said he had a simple "stunt" which he hoped we would like. He selected me to assist him. First he asked to be blindfolded securely to prove there was no trickery in it. Those present were to call out twenty-five numbers of three figures each, such as 161, 249, and so on. He asked me to write down the numbers as they were called.

This was done. MacDonald then astounded everyone by repeating the entire list of twenty-five numbers backwards and forwards. Then he asked people to request numbers by positions, such as the eighth number called, the fourth number, and so on. Instantly he repeated back the exact number in the position called. He did this with the entire list—over and over again, without making a single mistake.

Then MacDonald asked that a deck of cards be shuffled and called out to him in their order. This was done. Still blindfolded, he instantly named the cards in their order backwards and forwards. And then, to further amaze us, he gave us the number of any card counting from the top, or the card for any number.

You may well imagine our amazement at MacDonald's remarkable feat. You naturally expect to see a thing of this sort on the stage, and even then you look upon it as a trick. But to see it done by an everyday business man, in plain view of every one, blindfolded and under conditions which make trickery impossible, is astonishing, to say the least.

* * * * * * * *

ON the way home that night I asked MacDonald how it was done. He said there was really nothing to it—simply a memory feat, the key to which anyone could easily learn in one evening. Then he told me that the reason most people have bad memories is because they leave memory development to chance. Anyone could do what he had done, and develop a good memory, he said, by following a few simple rules. And then he told me exactly how to do it. At the time I little thought that evening would prove to be one of the most eventful in my life, but such it proved to be.

What MacDonald told me I took to heart. In one evening I made remarkable strides toward improving my memory and it was but a question of days before I learned to do exactly what he had done. At first I amused myself with my new-found ability by amazing people at parties. My "memory-feat," as my friends called it, surely made a hit. Every one was talking about it, and I was showered with invitations for all sorts of affairs. If anyone were to ask me how quickly to develop social popularity, I would tell him to learn my memory "feat"—but that is apart from what I want to tell you.

The most gratifying thing about the improvement of my memory was the remarkable way it helped me in business. Much to my surprise I discovered that my memory training had literally put a razor edge on my brain. My brain had become clearer, quicker, keener. I felt that I was fast acquiring that mental grasp and alertness I had so often admired in men who were spoken of as "wonders" and "geniuses."

The next thing I noticed was a marked improvement in my conversational powers. Formerly my talk was halting and disconnected. I never could think of things to say until the conversation was over. And, then, when it was too late, I would always think of apt and striking things I "might have said." But now I can think like a flash. When I am talking I never have to hesitate for the right word, the right expression or the right thing to say. It seems that all I have to do is to start to talk and instantly I find myself saying the very thing I want to say to make the greatest impression on people.

It wasn't long before my new-found ability to remember things and to say the right thing at the right time attracted the attention of our president. He got in the habit of calling me in whenever he wanted facts about the business. As he expressed himself to me, "You can always tell me instantly what I want to know, while the other fellows annoy me by dodging out of the office and saying 'I'll look it up.'"

* * * * *

I FOUND that my ability to remember helped me wonderfully in dealing with other people, particularly in committee meetings. When a discussion opens up the man who can back up his statements quickly with a string of definite facts and figures usually dominates the others. Time and again I have won people to my way of thinking simply because I could instantly recall facts and figures. While I'm proud of my triumphs in this respect, I often feel sorry for the ill-at-ease look of the other men who cannot hold up their end in the argument because they cannot recall facts instantly. It seems as though I never forget anything. Every fact I now put in my mind is as clear and as easy to recall instantly as though it were written before me in plain black and white.

We all hear a lot about the importance of sound judgment. People who ought to know say that a man cannot begin to exercise sound judgment until he is forty to fifty years of age. But I have disproved all that. I have found that sound judgment is nothing more than the ability to weigh and judge facts in their relation to each other. Memory is the basis of sound judgment. I am only thirty-two but many times I have been complimented on having the judgment of a man of forty-five. I take no personal credit for this—it is all due to the way I trained my memory.

* * * * * * * *

THESE are only a few of the hundreds of ways I have profited by my trained memory. No longer do I suffer the humiliation of meeting men I know and not being able to recall their names. The moment I see a man his name flashes to my mind together with a string of facts about him. I always liked to read, but usually forgot most of it. Now I find it easy to recall what I have read. Another surprising thing is that I can now master a subject in considerably less time than before. Price lists, market quotations, data of all kinds, I can recall in detail almost at will. I rarely make a mistake.

My vocabulary, too, has increased wonderfully. Whenever I see a striking word or expression, I memorize it and use it in my dictation or conversation. This has put a remarkable sparkle and pulling power into my conversation and business letters. And the remarkable part of it all is that I can now do my day's work quicker and with much less effort, simply because my mind works like a flash and I do not have to keep stopping to look things up.

All this is extremely satisfying to me, of course. But the best part of it all is that since my memory power first attracted the attention of our president, my salary has steadily been increased. Today it is many times greater than it was the day MacDonald got me interested in improving my memory.

* * * * * * * *

WHAT MacDonald told me that eventful evening was this: "Get the Roth Memory Course." I did. That is how I learned to do all the remarkable things I have told you about. The Publishers of the Roth Memory Course—The Independent Corporation—are so confident that it will also show you how to develop a remarkable memory that they will gladly send the Course to you on approval.

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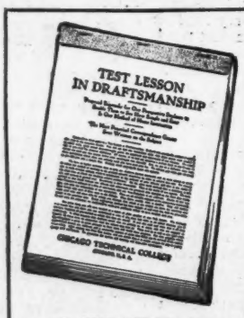

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Was $100
Before the War
Now $64

In these days when the cost of many things is higher than before the war, it is a distinct contribution to business-economy to offer through more direct selling methods such a great and decided saving on so popular a typewriter as the Oliver.

Only $4 a Month

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No money in advance. Not a cent! Simply make your request via the coupon below if you want this brand new Oliver Typewriter for five days free trial in your own home or office. Use this Oliver for five days as if it were your own. Type all your letters or any other work with it. Put it to every conceivable test. Compare it with any $100 typewriter on the market. Compare it for simplicity of construction. For beauty of finish. For ease of operation. For speed. For neatness of work. Then if after 5 days free trial you do not wish to keep the typewriter for any reason whatsoever, simply send it back to us and you won't be out one cent for the free trial. If, on the other hand, you decide that it is the finest typewriter, and you wish to keep it, then pay us at the easy rate of only $4 a month. This is the open, free trial offer we make to you on the Oliver to let you see for yourself that if any typewriter is worth $100 it is this splendid, speedy Oliver No. 9, our latest model and the finest we ever built.

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Check the coupon to get the Oliver for five days free trial in your own home. If you decide to keep the typewriter you can pay for it on terms so easy that you won't miss the money—only $4 a month. If you prefer to have further information before ordering, fill in the coupon for our free catalog. Clip the coupon now and mail at once.

Canadian Price, $82

The OLIVER Typewriter Company
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THE OLIVER TYPEWRITER COMPANY
1109 Oliver Typewriter Bldg., Chicago, Ill.

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DEPT. 30Y

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CHICAGO, ILL.

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Dept. 30Y

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Chicago, Ill.

Sir: Send at once fully prepaid and entirely free complete particulars of your great offer for this month.

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City ..... State .....

READ WHAT MY STUDENTS SAY:

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"When I enrolled—I knew nothing about Electricity. Today I am the highest paid workman for the Massena Light & Power Co."—C. C. Burkhart, Massena, N. Y.

"When I enrolled I was skeptical. Now I am convinced you have a fine method of teaching and can, and will, do all you say."—John McGee, New York City.

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Complete Letters Sent When You Write Me

YOU CAN DO IT

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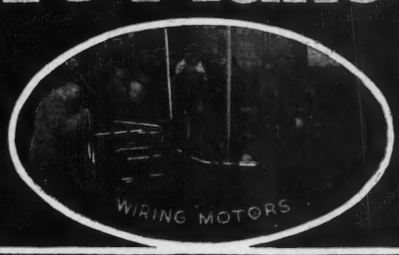
Sweeney Trains Men To Make Big Money



Any Young Man, Mechanically Inclined, Can Quickly and Efficiently Fit Himself to Earn Big Money by the *SWEENEY SYSTEM.* This system of practical instruction teaches men to be mechanics and experts in all branches of the automotive industries. Only at the SWEENEY SCHOOL can you get this system which has been endorsed by government and technical experts everywhere, and proven by years of success and the testimony of 35,000 graduates. Sweeney trains by having you do the work with your own hands. Hand, eye, and brain are trained together. Previous experience is not needed. Books are not used. Learn in 8 weeks and then step out into a big paying job with unlimited possibilities. We're ready for you and a bigger and better job.

$150 to $400 a month

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Chauffeurs	$100 and up
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Repair Men	$1.25 per hour
Truck Drivers	$35 per week
Taxicab Drivers	$25 per week
Trouble Shooters	$3 per hour
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Tractor Engineers	$8 per day
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Over 1 Million Dollars invested. Equipment alone worth over $350,000, of which $50,000 machine shop and aviation equipment has just been purchased.

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Earnestly yours,
EMORY J. SWEENEY, President.

EMORY J. SWEENEY, President
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Send me free your 72-page catalog and Sweeney School News and tell me of the opportunities in the auto and tractor business.

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15% to 20% more power, 30% less gas and no carbon when the air is moist as it is at night. Get these results constantly by moistening air from radiator. Thousands do. Practically no expense. Complete copyrighted instructions $1.00. Satisfaction or money refunded. Carl Laidlaw, Graettinger, Iowa.

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WELDING apparatus for all purposes. Small payment, balance five to ten months. Every mechanic needs one. Our plan is interesting. Write to-day. Bermo Welding Co., Cedar Rapids, Iowa, U. S. A.

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Classified Advertising Manager

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225 West 39th Street
New York City

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BUILD the Star Jr. Biplane. Send stamp for Circular "P." Chicago Aero Works, 326 River.

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USED Motorcycle Bargains: Indians, Excelsiors, Harleys. $40.00 up. Singles or twins. Overhauled, rebuilt and tested by experts. Shipped on approval and guaranteed. Send stamp for Big Free List. We furnish bank references. Floyd Clymer, Desk A, "Largest Motorcycle Dealer in Western America," Denver, Colorado.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

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WE do Metal Stamping, Gold, Silver, Nickel, Brass and Copper finishing. We will manufacture your article either on time or contract basis. If interested in large production write us. When on your die work you are always welcome at our diemaker's bench. Denning Mfg. Company, 1775-1777 East 87th Street, Cleveland, Ohio.

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500 FORMULAS. Trade Wrinkles, Secrets, Discoveries. All easy, successful money-makers. Lists free. Everything 25c. Edgar James, 315 Douglass, Indianapolis, Indiana.

1,000,000 FORMULAS. Trade secrets. 1016 pages $2. "Ideal," 5501-PS, North Robey, Chicago.

LONDON Jack's stovepipe and chimney cleaner formula 25c. Charles Dynes, Winchester, Indiana.

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FIFTY crackerjack formulas—no impractical antiques—automobile specialties, enamels, polishes, cements, etc., fifty cents. Emdon Specialty Bureau, P. O. Box 406, Brooklyn, New York.

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MODELS AND MODEL SUPPLIES

PATENTS—Book free. Send sketch for free Opinion of patentable nature. Talbert & Talbert, 4848 Talbert Building, Washington, D. C.

WE make working models for inventors, and carry a complete stock of brass gears and model supplies. Send for catalogue M.—The Pierce Model Works, 1837 North Karlov Avenue, Chicago, Illinois.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

AMERICAN MADE TOYS

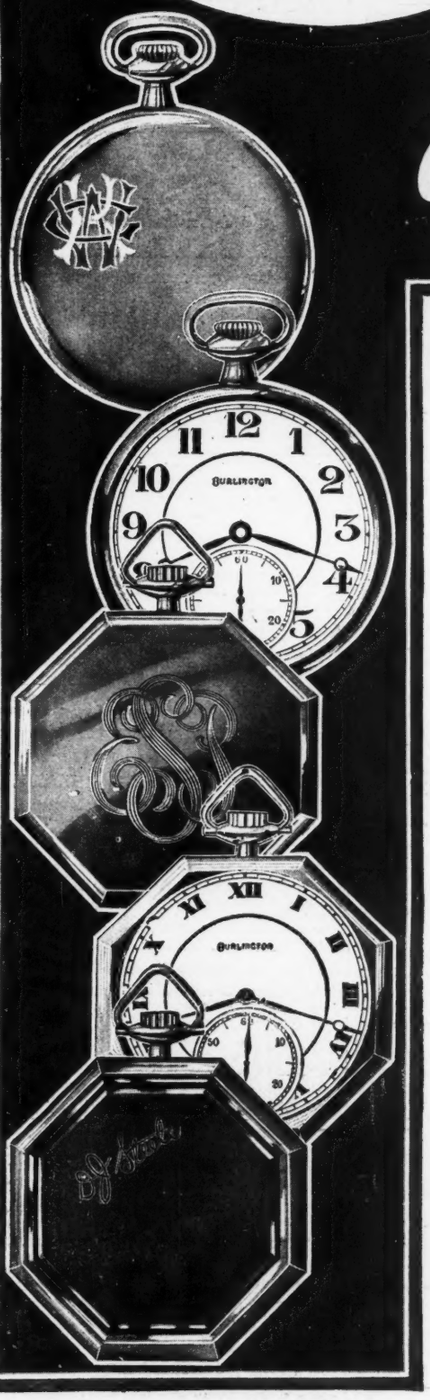
AN opportunity for homeworkers on small scale and manufacturers on large scale to make American Metal Toys. Army, Navy, Machine Guns, Cannons, Warships, Indians, Cowboys, Wild Animals, Whistles, Bird-whistles, Religious designs and other toys and Novelties. Greatest chance for industrious people to have an independent business. Enormous demand for cheap toys offers unlimited field and great future all over United States and foreign countries. Experience or tools not necessary. Hundred and more made complete per hour. Casting forms, complete outfit from $3.00 up. We buy these goods paying fixed prices. Attractive prices offered for painted goods. A strictly business proposition. No one need apply unless he means business. Booklet and information furnished free. We have no sales agents and we warn against worthless and cheap imitations. Toy Soldier Manufacturing Company, 32 Union Square, New York.

Quick-Action Advertisements continued on page 10

21 Ruby and Sapphire Jewels
Adjusted to the Second
Adjusted to Temperature
Adjusted to Isochronism
Adjusted to Positions
25-Year Gold Strata Case
Genuine Montgomery Railroad Dial
New Ideas in Thin Cases

Look!

Only $3.50 a Month



The Burlington

The Watchmakers' Masterpiece

JUST think of it! Only $3.50 per month—a great reduction in watch prices direct to you—a 21 jewel adjusted watch at rock-bottom price. Indeed, the days of exorbitant watch prices have passed.

See It First

You don't pay a cent to anybody until you see the watch. You don't buy a Burlington Watch without seeing it. Look at the splendid beauty of the watch itself. Thin model, handsomely shaped—aristocratic in every line. Then look at the works! These you will see the masterpiece of the watch maker's skill. A perfect time-piece adjusted to positions, temperature and isochronism.

Practically every vessel in the U. S. Navy has many Burlington watches aboard. Some have over 100 Burlingtons. The victory of the Burlington among the men in the U. S. Navy is testimony to Burlington superiority.

Send Your Name on This Free Coupon

Get the Burlington Watch Book by sending this coupon now. You will know a lot more about watch buying when you read it. You will be able to "steer clear" of the over-priced watches which are no better. Send the coupon today for the watch book and our offer.

Burlington Watch Co.
19th St. and Marshall Blvd.
Dept. 1369 Chicago, Illinois

Canadian Office:
338 Portage Ave., Winnipeg, Man.

Burlington Watch Co.
19th St. and Marshall Blvd.
Dept. 1369 Chicago, Ill.

Please send me (without obligation and prepaid) your free book on watches with full explanation of your cash or $3.50 a month offer on the Burlington.

Name .....

Address .....

.....

AUCTIONEERS

AUCTIONEERS and Bankers make big money. We teach both. Free catalog. Missouri Auction Banking School, Kansas City.

DUPLICATING DEVICES

"MODERN" Duplicator—a Business Getter, $2.25 up. 50 to 75 copies from pen, pencil, typewriter; no glue or gelatine. 35,000 firms use it. 30 days' trial. You need one. Booklet Free. J. V. Durkin & Reeves Company, Pittsburgh, Pennsylvania.

FOR THE HOME

GRANDFATHER'S Clock Works $5.00. Build your own cases from our free instructions. Everybody wants a hall clock. You can make good profit building artistic clocks for your friends. We replace worn-out works in old clocks with works having chimes at money saving prices. Write for folder describing the most beautiful hall clock ever sold at $35.00. Clock Co., Nicetown, Pennsylvania.

"LITTLE WONDER" Crown Capping Machines sell to every housewife, equal in efficiency to expensive power machines. Fastest sellers. Agents, Dealers, write. Mincke, Dept. C., Alhambra, California.

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STAMPING NAMES

MAKE $19.00 Hundred Stamping Names on Key checks. Send 25c for sample and instructions. PS Keytag Company, Cohoes, New York.

MISCELLANEOUS

5 MASTER KEYS, $1.00. Opens hundreds of different locks. The world's most wonderful set of keys. Master Key Company, 34 Manhattan Building, Milwaukee, Wisconsin.

AVOID Income Tax Worry and confusion. Use Ley's Ready Records during year. $1.50 Complete. Copper Journal, Hancock, Michigan.

ELECTRICAL Tattooing Machine, $3, $5, and $7. Catalogue for stamps. J. H. Temke, 1019 Vine, Psm., Cincinnati, Ohio.

BALDNESS. Indian's recipe for growing hair; astonishing success. Proof box mailed for 10 cents. John Hart Brittain, 150 East 32nd Street, BA-118, New York.

DID You Ever Lose Your Keys? Found yourself inconvenienced didn't you? Supply yourself with a Devil's Combination Master Key, which by actual test has opened hundreds of locks, and will prove very useful in an emergency. By mail, $1.00, Urich Key Company, Dept. B, Milwaukee, Wisconsin.

MANSFIELD'S Automatic Water Finder has made fortunes for many men and may make yours. Send for particulars to Edwin Mansfield, 94 Victoria Road, New Brighton, England.

IMMUNITY from infection. Use L-Wood Sanitary coverings for closet seats. Package containing 6, 15c postpaid. L-Wood, 460 Madison Avenue, Albany, New York.

PILES—For the latest scientific treatment write Elite Mfg. Company, 1004 Lawler Avenue, Auston, Chicago, Illinois.

GLASS SIGNS for rooms, furnished rooms, boarding, dress-making, cafes, restaurants, banks, offices, door name plates, house numbers, glass signs made to order. Write for price list. Penn Glass Sign Company, Fort Smith, Arkansas.

STILLS Water, liquids, all drinking purposes—half gallon hour. $15 prepaid. European Supply, Box 1682, Pittsburgh, Pennsylvania.

POULTRY Feeder, New principle. No waste. Sanitary. Booklet and Mash Formula Free. L. Kelly, Saranac, Michigan.

FOUR super keys 50c. Open over two hundred locks. Used by police, detectives, real estate, plumbers. Carry four in place of hundreds. Jansen, Locksmith, Box 254, Wolf Point, Montana.

HARDWOOD-FLOORS—Clean—renovate and refinish—your own floors. Instructions and formulas tell how, also care of floors. Price $1.00. Post Office Box 775B, Chicago, Illinois.

TELEGRAPHY

TELEGRAPHY (both Morse and Wireless) and Railway Accounting taught quickly. Tremendous demand. Big salaries. Great opportunities. Oldest and largest school; established 46 years. All expenses low—can earn large part. Catalog free. Dodge's Institute, K Street, Valparaiso, Indiana.

ADDING MACHINES

MARVELOUS new Automatic Adding Machine. Retails $12.50. Work equals $300 machine. Five-year-guarantee. Write for trial offer. Calculator Corporation, Dept. P, Grand Rapids, Michigan.

THE SESAME adds to 9,999,999. 25c. B10. Taylors Falls, Minnesota.

STAMMERING

STAMMERERS: My simple and natural method will correct your impediments. Instruction individual. Samuel E. Robbins, 246 Huntington Avenue, Boston.

ST-TUT-T-T-TERING and Stammering cured at home. Instructive booklet free. Walter McDonnell, 59 Potomac Bank Building, Washington, D. C.

INVENTIONS FOR SALE

WRAPPING tool for binding wire onto hose. Most efficient tool on the market for the purpose. Write for description and model, big field. Sell cheap. Wm. S. Downing, Houghton, Michigan.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

PRINTING, ENGRAVING, MULTIGRAPHING

MULTIGRAPH Letters build business. Most economical and effective advertising. Printing. Addressing. Low rates; careful work; service. Multigraph-Peerless Letter Company, 241 Fourth Avenue, New York.

833 FT. LABELS, $2.50. Save 30% on all. Wolf Labels, Station E, Philadelphia.

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LETTERHEADS $2.50 thousand. Samples free. Quality Print Shop, Marietta, Ohio.

GOOD Printing Reasonable. Machine composition, automatic printing presses, automatic envelope machinery. We print anything. Get our prices. A. H. Kraus, Kraus Building, Milwaukee, Wisconsin.

CITY printing at country prices. Write for samples and prices. Royal Printing Company, Sugarcreek, Ohio.

BETTER printing for less money! Send for our large package of samples of hundreds of items every user of printing is interested in. These samples worth dollars, will be sent for 10 cents to pay postage. Ernest Fantus Company, 525 South Dearborn Street, Chicago.

GUMMED labels! Rubber stamps! Catalog free. Edward Harrison, "Printing," Baltimore.

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SAVE 60% on engraving by using our Non-Plate Engraving Process. 50 wedding invitations, engraved, with double envelopes, $6.75. 100 visiting cards engraved, 75c postpaid. Office stationery, business announcements, etc. Samples and prices furnished upon request. Alden Non-Plate Engraving Company, 15 Avon Street, Boston, Massachusetts.

100 CARDS, business, professional, or social, card-case free, 75 cents. Agents wanted. G. B. Pratt, 68 Madison Street, Cortland, New York.

TYPEWRITTEN letters reproduced. Write for prices and samples. Joseph McGann, 1345 Park Road, Washington, D. C.

50,000 4-page, 6x9 circulars, Warren's Paper, $135.00. Other circulars proportionate. Times Printery, St. Francisville, Illinois.

ADVERTISING SERVICE

ADVERTISING prepared and placed in any publication. Letters, circulars, booklets written, illustrated and printed. Douglas Wakefield Coutlee, 1A West 34th Street, New York.

1,000 Advertising Headlines and Showcard Suggestions. Inspiration for advertisers. Mailed on receipt of 50c. Money back if you return book. Richards School of Advertising, 4305 Cottage Grove, Chicago.

SPECIAL! Inch display advertisement 150 magazines thrice $15. Globe Syndicate, Atlantic City.

ADVERTISE in 24 big Iowa dailies, 25 words $10.00; "They Pull." Advertisers Guide, free. Union Advertising, Baltimore Building, Chicago.

RICHARDSON'S Agency writes sane, sensible advertising. Folder free. Evanston, Illinois.

18 WORDS in 100 Magazines, $1.00. Lists Free. Stanford Corporation, Lancaster, Pennsylvania.

1000 CO-PUBLISHERS wanted! Terms—Registration, $3. Globe Syndicate, Atlantic City.

SALES Problems Solved. Complete facilities for marketing your article at a profit. Evans & Dubes, Fairbanks Building, Springfield, Ohio.

CONCORDIA Magazine, Quarterly, 2D Water Street, York, Pennsylvania. Advertising rates 4 cents a word, four times 12 cents a word.

TO reach the best paid workers in Michigan in Grand Rapids, Saginaw, Muskegon and Battle Creek try the list represented by the Michigan Associated Labor Press. One cent a word cash. One and one-half cent if charged. C. O. Taylor, 61 Market Avenue, Grand Rapids, Michigan.

LETTER SPECIALISTS

THE Secret of Writing Successful Letters revealed to you by Ad-Man Davison, the highest-paid letter writer in the world. Wonderful 976-page instruction course, including 500 successful letters. For Free Booklet address Desk 60, Opportunity Press, 681 Fifth Avenue, New York.

MAILING LISTS

NEW List. Guaranteed. $1.75 per 1000. Drake, Hitchcock, Oklahoma.

DON'T miss this offer! You get new business, quick cash returns, using fresh names mail order buyers, compiled printed September, 1920, farmers, rural folk, 2500, $5.00, trial 300, $1.00. Martinek 10 Company, 405 Lexington Avenue, New York.

OFFICE AND FACTORY EQUIPMENT

MULTIGRAPHS, Duplicators, Addressing, Folding, Sealing Machines. Bought, Sold and Rebuilt. Guaranteed. Office Device Company, 154A, West Randolph, Chicago.

MULTIGRAPHS, Addressographs, Duplicators, Sealers, Folders, less than half price. Guaranteed one year. Pruitt Company, 112-M North La Salle, Chicago.

ADDRESSOGRAPHS, Multigraphs, Duplicators, Folders, Sealers, Bought. Sold with Guarantee. Office Device Exchange, 503 Baltimore Building, Chicago.

TYPEWRITERS AND SUPPLIES

RE-MANUFACTURED typewriters at reduced prices. Shipped for 5 days' trial. Write for our Catalog No. 25 and save money. Beran Typewriter Company, 58 West Washington Street, Chicago.

FOREIGN LANGUAGE STUDY

SPANISH Language, most practical individual instruction by correspondence, $7.00 Monthly. Prunera's Spanish Studio, 180 Broadway, New York. (Established 1903).

POULTRY AND LIVE STOCK

RAISE poultry and rabbits—we tell how. Great rabbit book, 25c. Paper $1.00 year; both $1.15. Sample free. Poultry Advocate, Dept. B-42, Syracuse, New York.

FOR MEN AND WOMEN

MEN or Women—Enormous Profits Selling Duo Guaranteed Products. Easy sales at every house. All or spare time. Outfit free. Write quick. Duo Company, Dept. H66, Attica, New York.

BE a detective. Excellent opportunity, good pay, travel. Write C. T. Ludwig, 424 Westover Bldg., Kansas City, Missouri.

GENUINE Indian Baskets—Wholesale. Catalogue. Gilham, Highland Spring, California.

"SEXUAL Philosophy," 12c. Clear, specific, authoritative, complete, best, satisfies. Fred B. Kaessmann, Lawrence, Massachusetts.

DETECTIVES—Excellent opportunity. Fascinating work. Experience unnecessary. Particulars free. Write. American Detective System, 1968 Broadway, New York.

SEX books for advanced adult students and professionals. The most authoritative sex books including Kisch, Forel, Krafft-Ebing, etc. Send for list. Modern Book Society, 5 Hanson Place, Brooklyn, New York City, Desk 16.

MEN—Get Vital Strength. Retain youthful vigor. Wonderful results. Intensely interesting booklet free. The A. Gyde Company, Washington, D. C.

DOGS, BIRDS, PETS

READ the Rabbit Journal, St. Francis, Wisconsin. Two years, $1. Trial Subscription 25c.

FERRETS all kinds, price list free Glendale Ferret Company, Wellington, Ohio.

AIREDALES, Collies and old English shepherd dogs. Puppies all ages. Rabbits, Poultry, thoroughbred stock. Send 10c for list of what you want. W. R. Watson, Box 225, Oakland, Iowa.

EDUCATIONAL AND INSTRUCTION

MECHANICAL Drawing successfully taught by mail. Fifty cents each lesson. Pay as you learn. No other expense. Complete drawing outfit, valued at $20.00, free with the course. One hundred genuine blueprint lessons sent for full particulars and sample lessons. Albany Institute Mechanical Drawing, Dept. "A," Box 84, Albany, New York.

LINCOLN-JEFFERSON University, Home Study in College, Theological, Law, Music, Pharmacy, Business and Graduate Schools, Leading to degrees. Lock Box 239G, Chicago.

EARNINGS increased. Learn Berling's mathematical system. Price $1.00. Box 635, Indianapolis.

MAKE Big Money. Earn $10 to $25 daily. Be a show card writer. Fascinating profession. Enormous demand for window, show and advertising cards and signs. Wonderful course of instruction shows how to become expert. Given FREE to those who buy our assortment of Nobema Art Colors. Write at once for details of remarkable offer. Nobema Products Corporation, Dept. 2, Pleasantville, New York.

SPANISH—Spontaneous Method. You and I exchange letter in Spanish every day. Inexpensive. Particulars free. Guillermo Hedin, 3509 Franklin Avenue, St. Louis, Missouri.

PICTURES AND POSTCARDS

SPECIAL—Twenty clever, classy, assorted postcards 10c. prepaid. Swanson, 1205S Kansas Avenue, Kansas City, Kansas.

EVERYTHING in postcards. Live-wire list free. Worth-while samples 25c. Mention subjects preferred. Mutual Supply Company, Bradford, Pennsylvania.

JOIN Live Postcard Club. Membership Papers 10c. Harvey Teeple, Decatur, Indiana.

JOIN the Western Post Card Club. P. Fleming, Manager, Elk, Washington.

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PATENTS FOR SALE

PATENTS on two small metal novelties, for juvenile use, for sale. Alfred Plauschinat, 1725 North 19th Street, Philadelphia, Pennsylvania.

PATENT 1297399, wish market or sale same outright. George Pratt, Box 1700, Richmond, Virginia.

FOR SALE—Patent outright or royalty, Automobile Fender; new safety device to protect lives. M. Wilkenfeld, 1823 Bergen Street, Brooklyn, New York.

WE have a few practical money-making inventions for sale or trade. Adam Fisher Mfg. Co., 183B, St. Louis, Missouri.

GAMES AND ENTERTAINMENT

FOUR Magic Catalogs and Samples—15c. Gilmagico, Morgan Park, Illinois.

CHALK TALK, Illustrated in colors. Fine rag pictures. Lecture for pictures. Price $1.00. R. H. Johnson, 4514 South 20th Street, Omaha, Nebraska.

TRICKS, Escapes, Puzzles, Photos, Books. Catalogue free. Magicraft Co., Dept. E., Box 251, Detroit, Michigan.

MAGIC—Tricks, Jokes, Books, Pictures, Etc. Big catalog for stamp. United Sales Co., Springfield, Illinois.

TRICKS, Puzzles, Jokes, Plays, Wigs, Mind Reading Acts and Sensational Escapes. Send stamp for catalogue. Oaks Magical Company, Dept. 400, Oshkosh, Wisconsin.

GAMES, puzzles, magic tricks, books. Catalogue free. Pastime Circle, St. Louis, Missouri.

125 CARD Tricks, and how to do them. 25c. United Sales Co., Springfield, Illinois.

Quick-Action Advertisements continued on page 12

Why Live An Inferior Life?

Your Success Guaranteed

A Subtle Principle of Success

THIS SUBTLE PRINCIPLE in my hands, without education, without capital, without training, without experience, and **without study** or waste of time and without health, vitality or will power has given me the power to earn more than a million dollars without selling merchandise, stocks, bonds, books, drugs, appliances or any material thing of any character.

This subtle and basic principle of success requires no will power, **no exercise,** no strength, no energy, no study, no writing, no dieting, no concentration and no conscious deep breathing. There is nothing to practice, nothing to study and nothing to sell.

This subtle and basic principle of success does not require that you practice economy or keep records, or memorize or learn to do anything, or force yourself into any action or invest in any stocks, bonds, books, or merchandise.

This Subtle Principle must not be confused with memory systems, "will power" systems, Christian Science, psychology, magnetism, thrift or economy, nor should it be confused with health systems, auto suggestion, concentration, "personality," self-confidence or opportunity, nor should this Subtle Principle be confused with initiative, mental endurance, luck, chance, self-analysis or self-control. Neither should this principle be confused with imagination, enthusiasm, persuasion, force or persistence, nor with the art or science of talking or salesmanship, or advertising.

No one has yet succeeded in gaining success without it.

No one has ever succeeded in failing with it.

It is absolutely the master key to success, prosperity and supremacy.

When I was eighteen years of age, it looked to me as though I had absolutely no chance to succeed. Fifteen months altogether in common public school was the extent of my education. I had no money. When my father died, he left me twenty dollars and fifty cents, and I was earning hardly enough to keep myself alive. I had no friends for **I was a negative** and of no advantage to any one. I had no plan of life to help me solve any problem. In fact, I did not know enough to know that life is and was a real problem, even though I had an "acute problem of life" on my hands. **I was blue and despondent** and thoughts of eternal misery arose in my mind constantly. I was a living and walking worry machine.

I was tired, nervous, restless. I could not sleep. I could not digest without distress. I had no power of application. Nothing appealed to me. Nothing appeared worth doing from the fear that I could not do anything because of my poor equipment of mind and body. I felt that I was **shut out** of the world of success and I lived in a world of failure.

I was such a pauper in spirit that I blindly depended on drugs and doctors for my health, as my father before me. I was a "floater" and **depended on luck** for success. The result of this attitude on my part was greater weakness, sickness, failure and misery as is always the case under similar conditions.

Gradually my condition became worse. I reached a degree of misery that seemed intolerable. I reached a crisis in my realization of my failure and adverse condition.

Out of this misery and failure and pauperism of spirit—out of this distress—arose within me a desperate reaction—"a final effort to live"—and through this reaction, arose within me, the discovery of the laws and principles of life, evolution, personality, mind, health, success and supremacy. Also out of this misery arose within me the discovery of the inevitable laws and principles of failure and sickness and inferiority.

When I discovered that I had unconsciously been employing the principles of failure and sickness, I immediately began to use the principles of success and supremacy. **My life underwent an almost immediate change.** I overcame illness through health, weakness through power, inferior evolution by superior evolution, failure by success, and converted pauperism into supremacy.

I discovered a principle which I observed that all successful personalities employ either consciously or uncounsciously. I also discovered a principle of evolution and believed that if I used it, that my conditions would change, for, I had but one disease—failure, and therefore there was but one cure—success, and I began to use this principle and out of its use arose my ambition, my powers, my education, my health, my success and my supremacy, etc., etc.

You may also use this principle of success deliberately, purposefully, consciously and profitably.

Just as there is a principle of darkness, there is also a principle of failure, ill health, weakness and negativeness. If you use the **principle of failure** consciously or unconsciously, you are sure always to be a failure. Why seek success and supremacy through blindly seeking to find your path through the maze of difficulties? Why not open your "mental eyes" through the use of this subtle success principle, and thus deliberately and purposefully and consciously and successfully advance in the direction of supremacy and away from failure and adversity?

I discovered this subtle principle—this key to success—through misery and necessity. You need never be miserable to have the benefit of this subtle principle. You may use this success principle just as successful individuals of all time, of all countries, of all races, and of all religions have used it either consciously or unconsciously, and as I am using it consciously and purposefully. **It requires no education,** no preparation, no preliminary knowledge. Any one can use it. Any one can harness, employ and capitalize it, and thus put it to work for success and supremacy. Regardless of what kind of success you desire, this subtle principle is the key that opens the avenue to what you want.

It was used by

Moses,	**Clemenceau,**	**Mozart,**
Caesar,	**Marshall Field,**	**Mendelssohn,**
Napoleon,	**Sarah Bernhardt,**	**Copernicus,**
Roosevelt,	**Galili-Curci,**	**Confucius,**
Rockefeller	**Nordica,**	**Mohammed,**
Herbert Spencer,	**Melba,**	**Cicero,**
Emerson,	**Cleopatra,**	**Demosthenes,**
Darwin,	**Alexander the Great,**	**Aristotle,**
Morgan,	**Edison,**	**Plutarch,**
Harriman,	**Newton,**	**Christopher Columbus,**
Woodrow Wilson,	**Wanamaker,**	**Vanderbilt,**
Charles Schwab,	**Phil Armour,**	**Marcus Aurelius,**
Lloyd-George,	**Andrew Carnegie,**	**Pericles,**
Charles E. Hughes,	**Frick,**	**Lycurgus,**
Abraham Lincoln,	**Elbert Hubbard,**	**Benjamin Franklin**
	Shakespeare,	
	George Washington,	

and thousands and thousands of others—the names of successful men and women of all times and of all countries and of all religions, and of all colors, make a record of the action of this Subtle Principle of Success. None of these individuals could have succeeded without it—no one can succeed without it—no one can fail with it.

Every one realizes that human beings owe a duty to each other. Only the very lowest type of human being is selfish to the degree of wishing to profit without helping someone else. This world does not contain very great numbers of the lowest and most selfish type of human beings. Almost everyone, in discovering something of value, also wants his fellowman to profit through his discovery. This is precisely my attitude. I feel that I should be neglecting my most important duty towards my fellow human beings, if I did not make every effort—every decent and honest effort—to induce everyone to also benefit to a maximum extent through the automatic use of this subtle principle.

I fully realize that it is human nature to have less confidence in this Principle because I am putting it in the hands of thousands of individuals, but I cannot help the negative impression I thus possibly create. I must fullfill my duty to each member of humanity just the same.

I do not urge anyone to procure it because I offer it without any obligation whatsoever. I urge everyone to procure the Subtle Principle of Success because the results it holds in store for each individual are great—very great.

This subtle principle is so absolutely powerful and overmastering in its influence for good, profit, prosperity and success, that **it would be a sin** if I kept it to myself and used it only for my personal benefit.

So sure am I of the truth of my statements—so absolutely positive am I of the correctness of my assumption and so absolutely certain am I that this Principle in your hands will work wonders for you—that I am **willing** to place this Subtle Principle of Success in your hands, at my expense, without any obligation whatsoever, on your part. You will recognize the tremendous value of this Principle within less than thirty minutes—in fact, almost immediately, as you become conscious of it, you will realize its practicability, its potency, its basic reality and its power and usability for your personal profit, pleasure, advancement, prosperity, success and supremacy.

Thousands of individuals claim that the Subtle Principle of Success is worth a thousand dollars of anyone's money. Some have w ritten that they would not take a million dollars for it. You will wonder that I do not charge a thousand dollars for the Subtle Principle of Success—for disclosing this Principle—after you get it into your possession and realize its tremendous power and influence for your success and supremacy.

I, myself, have derived such tremendous results—amazing results—from its po wer, that I want every man and woman to have this key to success, prosperity, wealth and supremacy. T his is why I am willing to send it to any one—to any address, without any obligation whatsoever—this Subtle Principle of Success is yours to keep, yours to use for the attainment of your success, happiness and supremacy.

Remember you are under no obligation whatsoever, to pay or to return anything to me. The Subtle Principle of Success is yours to keep.

You would never forgive me, and I could never forgive myself, nor could the creative forces of the Universe forgive us, if I failed to bring you to the point of using this subtle principle of success. **You would never forgive me** if I failed to do for you that which you would do for me, if our positions were reversed.

You want success of some kind. This is your opportunity to get it—to get what you want.

Write your address on the form below, or write me a postal or a letter, asking me to send you the Subtle Principle of Success without any obligation of any kind whatsoever, on your part, and you will receive by return mail the Subtle Principle of Success—a Principle of supremacy—the key to your every success—the equal of which you have never seen.

ALOIS P. SWOBODA, 814 Berkeley Bldg., West 44th Street, New York City

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ALOIS P. SWOBODA, 814 Berkeley Building, West 44th Street, New York City

You may send me at your risk and expense, the Subtle Principle of Success.

I promise you and myself to help myself to the utmost through the Subtle Principle of Success.

I promise to accept the Subtle Principle of Success with an eager and open mind for my advantage.

I am above seventeen years of age and I am sincere and honest in my statements and promises.

It is understood that I am not obligated to return or to pay for the Subtle Principle of Success.

Name .....
(write plainly)

Address .....

City .....

State .....

Note—The above statement in Popular Science Monthly is absolutely guaranteed in every way to be as represented.

PHOTOGRAPHY AND SUPPLIES

MAIL us 20c with any size film for development and six velvet prints. Or send six negatives any size and 20c for six prints. Or send 40c for one 8x10 mounted enlargement. Prompt, perfect service. Roanoke Photo Finishing Company, 212 Bell Avenue, Roanoke, Virginia.

FILMS developed 5c roll, prints 3c each. Photo Service, 929 McMillan, Cincinnati, Ohio.

DISABLED Soldiers Photo Company, 3654 North Halsted Street, Chicago. Films developed 7c. Trial prints 3c. Post cards, 5c. Work guaranteed.

MR. ADVERTISER: Ask to-day for a copy of the "Quick Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

OHIO man sends five orders inside twenty days: 78 prints, remits $4.50. Crazy? No! "Dee-lighted." Cause: Polished silvertone prints. Try 'em! Six for 20c silver. Send roll or negatives, developing always free. "Silvertone," 950 B. Lockwood, Chicago.

SPECIAL offer—Your next kodak film developed 10c., and first six prints 2c. each. 24 hours service. Enclose money with order. Write for price list "3" and sample print. Johnston & Tunick, 53 Nassau Street, New York.

PHOTOGRAPHERS—Mallinckrodt's pure Hydrochinone, $2.65 pound, prepaid. Grant Myers, Summit, New Jersey.

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Quick Action Advertisements continued on page 14

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I MEAN just what I say. There's no trick or catch about it. Give me five days and I'll prove that I can get your pay raised for you. I'll do it on a "show you" basis. You get the proof before you pay me a cent.

You've probably heard of me. My name is Pelton. Lots of people call me "The Man Who Makes Men Rich." I don't deny it. I've done it for thousands of people—lifted them up from poverty to riches. There's no sound reason why I cannot do it for you. So let's try.

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Among them are such men as Judge Ben B. Lindsay; Supreme Court Justice Parker; Gov. McKelvie, of Nebraska; Wu Ting Fang, Ex-U. S. Chinese Ambassador; Governor Ferris, of Michigan; and thousands of others of equal prominence. Some of the things this "secret" has done for people are astounding. I would hardly believe them if I hadn't seen them with my own eyes. Adding ten, twenty, thirty or forty dollars a week to a man's income is a mere nothing. That's merely playing at it. Listen to this:

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I could tell you thousands of similar instances. But there's no need to do this as I'm willing to tell you the "secret" itself. Then you can put it to work and see what it will do for you. I don't claim I can make you rich over night. Maybe I can—maybe I can't. Sometimes I have failures—every one has. But I do claim that I can help 90 out of every 100 people if they will let me.

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If you pass this offer by, I'll be out only the small profit on a $4.00 sale. But you—you may easily be out the difference between what you're making now and an income several times as great. So you see you've a lot—a whole lot—more to lose than I.

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AGENTS: Sell our accident and sickness policies in your spare time. Pay $5000 death, $25 weekly benefit. Premium $10 yearly. Permanent income from renewals. Easy seller. Liberal commissions. Insurance Company, Dept. J-6, Newark, New Jersey.

DON'T read this unless you want a real live proposition. Combination Joke and Clutch Pencil, nickeled case, heavy metal, each with pocket clip. Big joke and for actual use. Sells at sight for $1.00. Send 50c for sample. Agent's cost in orders. Ten or more 35c each. 185% profit. Write for sample and agency. Ash Novelty Company, 1107 Xenia Avenue, Dayton, Ohio.

WATER STILLS, made entirely of heavy copper, one or four gallon capacity. Prices $30.00 and $50.00 respectively. Shipped prepaid by express or parcel post the same day we receive your order. Ideal for distilling water for automobile batteries, industrial uses and drinking purposes. References: U. S. National Bank, or Bradstreets, Omaha, Boyer & Co., P8 519 Farnham Building, Omaha, Nebraska.

SELL necessities. Everybody needs and buys the "Business Guide." Bryant cleared $800 in July. Send for sample. It's free. Nichols Company, Box 1B, Naperville, Illinois.

GET our plan for selling Arion Phonographs at home. No canvassing. Quality equal to high priced instruments sold in stores. Low price gets you the business—quality builds more business for you. Big profits. Write today. Arion Phonograph Company, 1212 Arion Building, Elkhart, Indiana.

EASY Oilers for Ford Engines make "Easy Money" for Dealers and Agents. Sample $1. Write for agency. Magee & Company, Woodward Building, Washington, D. C.

FOOLPROOF paint-varnish remover, money back guarantee. Martinek 10 Company, 405 Lexington Avenue, New York.

MEN, get into the wonderful tailoring agency business, big profits taking orders and your own clothes free. We furnish fine sample outfit and everything free. No experience needed. Write today. Banner Tailoring Co., Dept. 754, Chicago.

DOLLAR specialty. Costs 25c. Universally needed. Many buy hundreds. Make $15 daily. 202 Pennsylvania Building, Philadelphia.

WORLD'S fastest selling auto accessory! County distributors wanted; write today. G. L. W. Spring Oiler Co., San Diego, California.

350% profit. Quick Seller. Klean-Rite Magic Washing Compound. Washes Clothes without rubbing. Sells 25c, you make 19c. Samples free. Bestever Products Company, 3253-P, Belleplaine, Chicago.

LUMINOUS PAINT—Makes any article visible in the dark. Bottle, 50c. Guaranteed. Sample, particulars for "Red" stamp. Illuminant Company, 744LP North Lockwood, Chicago.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

STOCK in pocket, $10.00 profit. No risk! Don't have to buy. Sample, Quarter. Try it. You ought to! Returned if you don't wish to try. V. B. Company, Pearl River, New York.

WATER STILLS, made of heavy copper; two gallon capacity, $25, four gallon, $40. Suitable for distillation of all liquids. Directions given. N. J. Richard & Company, 200 Broadway, C310, New York City.

BIG money varnishing floors, woodwork, etc., $1.00 brings you directions for making brilliant oil varnish at $.75 per gallon. C. Parker, Box 1234, Seattle, Washington.

WERE You Ever Offered A Grocery Store? You can handle Sugar, Flour, Canned Goods, Dried Fruit, Coffee and entire line of Groceries, as well as Paints, Roofing, Aluminum Ware and Automobile Oils, with no rent to pay; no money invested; take large orders from samples. Goods are guaranteed and proven quality. Selling experience not necessary. Steady, profitable work for "workers." Address Hitchcock-Hill Company, Dept. 220, Chicago, Illinois. Reference: Any Bank or Express Company.

BIGGEST—Best Money Maker Guaranteed—Wonderful Proposition. Big Holiday Success. Only Safety Razor Cannot Cut Yourself, $1.00. Standard Safety Razor Corp., Pittsburgh, Pennsylvania.

AGENTS to Travel by automobile to introduce our fast selling popular priced household necessities. The greatest line on earth. Make $10 a day. Complete outfit and automobile furnished Free to workers. Write today for exclusive territory. American Products Co., 2357 American Bldg., Cincinnati, Ohio.

MAKE $50 Daily—Something New—400% Profit. Free Sample. Business, Professional Men re-order weekly. Retails $5.00. Your Profit $4.00. Write for State Rights quickly. Headquarters, Drawer 596, Hartford, Connecticut.

AGENTS: We pay $6 a day taking orders for New Kerogas Burner. Fits any stove. Burns cosiol. No experience or capital required. Work spare time or full time. Write for demonstrating sample. Thomas Mfg. Co., Class 2661, Dayton, Ohio.

AGENTS make big money because sales may be made in every home. Our modern aids to home sanitation have an appeal that cannot be resisted. A brush, mop or duster for every need. Liberal commissions and good territory. North Ridge Brush Company, 136 Clark Street, Freeport, Illinois.

MAKE $30.00 next Saturday. Speederator for Fords selling like wildfire. Used by Ford Motor officials. Makes any Ford run like a Packard. Stops stalling and bucking. Put on quick—instant satisfaction. No holes to bore. Sell ten to twelve a day easy. Splendid profits and exclusive territory. Write quick for information. Address Perrin Company, 1072 Hayward Building, Detroit, Michigan.

SALESMEN—Side or main line, to sell low-priced 6,000 mile guaranteed automobile tires, 30x3½ non-skid sells for $13.95; other sizes in proportion. Good money-making proposition for live wires. Master Tire Co., 1414 South Michigan, Chicago.

BIG PROFITS selling Duplex Transformers. Every auto owner needs them. Save gas. Banish spark plug trouble. Exclusive territory. Write quick. Jubilee Mfg. Company, 14 Station C, Omaha, Nebraska.

MEN wanted to sell groceries. Selling experience not necessary. One of the World's largest wholesale Grocery houses (capital over $1,000,000.00) wants ambitious men in your locality to sell direct to consumer nationally known brands of an extensive line of groceries, paints, roofings, lubricating oils, stock foods, etc. No capital required. Commissions advanced. Write today. State age and county desired. John Sexton & Company, 363 West Illinois Street, Chicago, Illinois.

"LITTLE WONDER" Crown Capping Machines sell to every housewife, equal in efficiency to expensive power machines. Fastest sellers. Agents, Dealers, write. Mincke, Dept. F, Alhambra, California.

AGENTS Sensational Hit. New Rubberized Gingham Aprons; attractive; waterproof; rapid seller; particulars. Eyre & Lee, Box 152 N. S. Station, Pittsburgh, Pennsylvania. Dept. 78.

$6000.00 A YEAR is your profit from 4 sales a day. Davidson sold 96 one week. No experience needed. The Aladdin light is a sensation wherever introduced. 5 times as bright as electric. Won Gold Medal. Farmers have the money, they need this light and 9 out of 10 will buy. Also big opportunity in small towns and suburbs. Excellent spare time and evening seller. No Capital Required. Sample on free trial. Write for agency proposition while territory still open. Mantle Lamp Company, 524 Aladdin Building, Chicago.

$15.00 DAILY selling the New Amberoid Unbreakable Combs; kind you can hit with a hammer; write for wholesale prices. J. Bucknam, Box 2792, Boston, Massachusetts.

AGENTS wanted to sell the famous "Flexedge" engine valves that are guaranteed not to pit, warp, leak, crack or need regrinding. Automobile owners buy them readily because they are a good financial investment. They are used as regular equipment by prominent manufacturers of automobiles and by builders of oil burning engines. An attractive proposition awaits your request. S. S. V. Co., 706 Townsend Street, Chicago.

AGENTS: Something brand new. "Lionprip" Safety for lamps. All families want them. 10c brings samples. A. L. Higgins Mfg. Company, Bar Harbor, Maine.

MEN and women agents wanted to sell a household article which is far superior to similar and extensively advertised devices. It sells easily at $1.50, costs 75c. Our agents sell 15 to 30 a day earning $10.00 to $20.00 a day. Good article for crew manager. Ladies can easily sell to neighbors and friends. Send 75c for a sample prepaid. Free catalog of other good sellers. Excellent opportunity to establish independent permanent growing business. Lafayette Brush & Mfg. Company, 1034 Rising Sun Avenue, Philadelphia, Pennsylvania.

AGENTS. Spark Intensifier Transformer. All Cars. More Pep. Less Gas. Large Profits. Get our prices. Automote Manufacturing Company, 2246 North Central Park, Chicago.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

AGENTS! Side-line men! Lite-o-Rite is the fastest selling novelty ever produced. Perfect combination pocket pencil and cigar lighter. Sells to cigar, drug, stationery, novelty, premium, punch board trade, etc. Send $5.40 for sample dozen. Money back guarantee. The Art Metal Works, Dept. S., Newark, New Jersey.

I WANT 100 men and women quick to take orders for Comer raincoats and waterproof aprons. Everybody buys. McCrary's profits last year were $5,218. New styles—wonderful bargains—direct from manufacturer to wearer. Barnes made $523 in thirty days. Tremendous profits for you. $2,500 a year for three average orders a day. $10 a day for your spare time. No delivering nor collecting. No capital required. I furnish everything, including beautiful sample coat. Write quick for liberal offer. The Comer Mfg. Co., Dept. 0-41, Dayton, Ohio.

AGENTS wanted to sell our 25 light acetylene gas generator; fully guaranteed; cheap; safe and reliable. Write Daniel Zimmerman, Magley, Indiana.

HELP WANTED

DETECTIVES earn big money. Great demand. Travel. Experience unnecessary. We train you. Particulars free. Write, American Detective System, 1968 Broadway, New York.

BE a detective. Excellent opportunity, good pay, travel. Write C. T. Ludwig, 424 Westover Bldg., Kansas City, Missouri.

STOP daily grind. Start silvering mirrors. Auto headlights, tableware. Plans free. Clarence Sprinkle, Dept. 95, Marion, Indiana.

GET on the Stage. I tell you how! Send stamp for instructive Stage Book and particulars. A. La Delle, Box 557, Los Angeles, California.

BE a Mirror Expert, $3-$10 a day; spare time home at first; no capital; we train, start you making and silvering mirrors, French method. Free prospectus. W. F. Derr, Pres., 579 Decatur Street, Brooklyn, N. Y.

FIREMEN, Brakemen, Baggagemen, $140-$200, Colored Porters, by railroads everywhere. Experience unnecessary, 830 Railway Bureau, East St. Louis, Illinois.

MEN—Age 17 to 45. Experience unnecessary. Travel, make secret investigations, reports. Salaries, expenses. American Foreign Detective Agency, 321, St. Louis.

Secrets of Selling that Make These Men $10,000 a Year Star Salesmen

Some Amazing Stories of Quick Success

IT is hard to believe that a man who has been working for years in a routine job at small pay could almost over-night step into the $10,000 a year class. Yet that is just what many men have done and are doing today. That such big success could come so quickly and so easily seems almost incredible. If I should tell you that one man who had been a fireman on a railroad stepped from his old job to one that paid him $10,000 a year, you would be inclined to doubt the truth of my statement.

But I can show you the man's own story. And that is only one instance. I can show you many more. And perhaps the most surprising part of it all is that these men were just average men. They came from all walks of life, from all fields of work. They had previously been clerks, bookkeepers, mechanics, farm hands! Some of them had never earned more than $60 a month—some of them had drudged for years at dull, uninteresting work without prospects of anything better in life. And then, in one quick jump, they found themselves earning more money than they had ever thought possible. Suddenly all their dreams of success, position, and financial independence came true.

The Secret of Their Success

What was responsible for their remarkable rise to the ranks of the big money makers? What did they do to lift themselves out of the low pay rut and step to magnificent earnings?

The answer is very simple. These men decided to get into the great field of *Selling*—they learned about the wonderful opportunities in this fascinating profession—why salesmen are always in demand—why they receive so much more money than men in other fields of work. And they became Star Salesmen!

Probably if you had told any one of these men that it was possible for him to become a Star Salesman he would have laughed at the idea. If you had told him that it was not only possible, but that it could be done in his spare moments at home, without interfering with his work, he would have dismissed your statement as being too absurd to be even considered. For you must remember that most of those men had never had a day's experience in Selling—they had no special qualifications for Salesmanship—no thought of ever becoming Salesmen.

What Makes a $10,000 a Year Star Salesman?

As a matter of fact, these men who are today reaping such handsome rewards as Star Salesmen, would probably be working still as clerks, bookkeepers, mechanics, etc., if they had not learned about the National Salesmen's Training Association's system of Salesmanship Training and Free Employment Service. This is an organization of top-notch Salesmen and Sales Managers formed just for the purpose of showing men how to become Star Salesmen and fitting them into positions as City and Traveling Salesmen.

Send Me Your Name

I have shown hundreds of men how to step from small-pay jobs into the big money class in one quick jump. $10,000 a year—yes, and more—has come to men as a result of writing to me. Just let me send you the whole amazing proof—entirely free of cost or obligation—J. E. Greenslade, President, N. S. T. A.

Into the Big Pay Class in One Jump!

Earned $524 in Two Weeks

I had never earned more than $60 a month. Last week I cleared $306 and this week $218. You have done wonders for me.—Geo. W. Kearns, 107 W. Park Place, Oklahoma City, Okla.

I Now Earn as High as $100 a Day

I took your course two years ago. Was earning $15 a week clerking. Am now selling many of the largest firms in the U. S. I have earned more than $100 in a day. You secured me my position. Our Sales Manager is a graduate of yours.—J. L. DeBonis, 1628 S. Crawford Ave., Chicago, Ill.

Earned $1,800 in Six Weeks

As soon as I received a letter from you and your literature, I knew that I was on the right track, and very soon after I applied for a position as a Salesman to one of the firms whom you informed me were in need of a Salesman and to whom you had recommended me. My earnings for March were over $1,000 and over $1,800 for the last six weeks, while last week my earnings were $356.

The N.S.T.A. dug me out of a rut where I was earning less than $1,000 a year and showed me how to make a success.—J. P. Overstreet, Dallas, Tex.

Through its help hundreds of men have been able to realize their dreams of big opportunity, success, wealth and independence. Men without previous experience or special qualifications have learned the secrets of selling that make Star Salesmen—for Salesmen are not "born" but made, and any man can easily master the principles of Salesmanship through the wonderful system of the National Salesmen's Training Association. Anyone who is inclined to doubt that this is so has only to read the stories of men who tell in their own words what the Association has done for them. Here are just a few examples:

J. P. Overstreet of Dallas, Texas, who was formerly on the Capitol Police Force of Washington, D. C., states: "My earnings for March were over $1,000 and over $1,800 for the last six weeks, while last week my earnings were $356. The N. S. T. A. dug me out of the rut where I was earning less than $1,000 a year and showed me how to make a success."

C. W. Campbell, of Greensburg, Pa., writes: "My earnings for the past thirty days are $1,562 and I won Second Prize in March, although I only worked two weeks during that month."

What These Men Have Done You Can Do

It will not cost you a penny to learn how you, too, can become a Star Salesman and take your place among the big money makers of business. Whatever your ambition may be—$5,000, $10,000 or more a year—find out about *your* great opportunity in the wonderful profession of Salesmanship. See how the N. S. T. A. can open to you the way to a big selling job, to prosperity and a life of fascinating work, travel, contact with influential men. Just mail the coupon or write, and you will receive, without cost or obligation, proof of what the remarkable system of the National Salesmen's Training Association and its FREE EMPLOYMENT SERVICE can do for you. In addition a great book on Salesmanship will be mailed to you without charge. You owe it to yourself to read of the quick and brilliant success that others have achieved and of the opportunities that await you in the field of Selling. Mail the coupon or write today.

National Salesmen's Training Association,
Dept. 15-W Chicago, Ill., U. S. A.

National Salesmen's Training Association,
Dept. 15-W, Chicago, Ill., U. S. A.

Send me Free Proof that you can make me a Star Salesman and tell me how you will help me land a selling job. Also list showing lines of business with openings for Salesmen. This does not obligate me in any way.

Name.....

Street.....

City.....

State.....

FREE BOOK

Leads Way to

$5,000 TRAFFIC JOBS

100,000 High-Salaried Men Needed!

ARE you interested in quickly obtaining a big job in a new uncrowded profession eager for your trained services? Traffic Management offers you a field filled with splendid opportunities now easy for you to grasp. Never before has such a chance come to you and it may never come again. 100,000 high-salaried Traffic men are needed at once, to handle efficiently the tremendous amount of traffic which is crowding the railroads and steamship companies to capacity. $3,000 to $5,000 a year is gladly paid. And now comes to you the opportunity to quickly obtain one of these fine traffic positions.

Exchange Your Spare Time For A Big Traffic Job

Now through the American Commerce Association you receive the help of many of America's greatest traffic managers in preparing for this fascinating field. Because of the tremendous need for traffic managers these famous experts of the Association's staff are eager to put you on their list to be trained for one of the big positions open. Railroads, shippers and ship owners are literally crying for traffic men. You don't have to quit your present job in order to prepare for one of these positions. Such men as T. Albert Gantt, Traffic Manager, Corn Products Refining Company; William Scott Cowie, American Freight Board Committee; Samuel G. Lutz, Vice President, Chicago & Alton R. R., and nearly 200 others of equal prominence train you quickly and thoroughly in your spare time and at a cost so trifling that any ambitious man can easily take advantage of this great opportunity.

Traffic Men Earn Big Money Because They Save Their Firms Big Money

It is easy to understand why traffic men are in such need and why they receive such big salaries. A traffic man recently saved his concern $24,000 on shipments to their new plant in Chattanooga. Another saved $9,751 in shipping 66 carloads in two weeks. Another saved his firm $36,000 by applying a differential rate on 1,500 cars from Pittsburgh to Canada.

Traffic Experts saved an automobile concern $640,000 in ten months. A traffic expert discovered that freight rates paid by the Meaker Coal Company were legal, but exorbitant. A ruling secured from the Interstate Commission resulted in a refund of $122,000. An oil shipper in Kansas was losing over $30 every day—$720 monthly—because he did not know of certain tariff regulations entitling him to lower rates.

Is it any wonder that the traffic experts who can save their employers hundreds and thousands of dollars in freight charges are highly paid? Such knowledge can almost dictate its own salary.

MAIL COUPON FOR FREE BOOK

"Swap" your spare time for a big traffic job. Mail coupon now for free book. Explains why firms all over the country are needing trained traffic men to handle their shipping and traffic problems economically and efficiently. Gives full information about opportunities open to you and how you can earn $5,000 a year and more in this interesting profession. This free book will open your eyes to a new, uncrowded profession just as eager for your trained services as to pay you big money for them. Mail Coupon today.

AMERICAN COMMERCE ASSOCIATION
Dept. 1412, 4043 Drexel Blvd., Chicago, Ill.

American Commerce Association,
Dept. 1412, 4043 Drexel Blvd., Chicago, Ill.

Please send me without obligation, your new book, "A New Profession," and tell me how I can qualify for Traffic Management.

Name_____

Address_____

MEN wanted. I want a few more men to train as draftsmen. Experience not necessary. Draftsmen earn $150 to $300 per month and more. Big demand. Splendid opportunities. Learn quickly at home. Let me send you Free Lesson. No charge. Address: Charles M. Morey, Director, 2239 Chicago Technical Building, Chicago, Illinois.

SILVERING mirrors, French plate taught. Easy to learn, immense profits. Plans free. Wear Mirror Works, Excelsior Springs, Missouri.

RAILWAY traffic inspectors earn from $110 to $200 per month and expenses. Travel if desired. Unlimited advancement. No age limit. We train you. Positions furnished under guarantee. Write for Booklet CM-13, Standard Business Training Institute, Buffalo, New York.

PATENTS—Book free. Send sketch for free opinion of patentable nature. Talbert & Talbert, 4846 Talbert Building, Washington, D. C.

—BE an Expert Penman. Wonderful new device guides your hand, corrects your writing in few days. Complete outline Free. Write Mr. Osment, 52, St. Louis, Missouri.

MEN wanted for Detective Work. Write J. Ganor, Former Government Detective 115, St. Louis, Missouri.

WRITE Photoplays; $50 each. Experience unnecessary; details free to beginners. Producers' League, 194, St. Louis.

BIG demand for graduate electrical experts. Prepare quickly under Electrical Engineer. Thorough Home Study Methods. Small Expense. Albert Wood Wicks, E. E., Dept. 1777, 431 South Dearborn Street, Chicago.

BE A DETECTIVE—Big Pay; nice work; write Wagner, 186 East 79th, New York, Dept. 226.

MEN, get into the wonderful tailoring agency business, big profits taking orders and your own clothes free. We furnish fine sample outfit and everything free. No experience needed. Write today. Banner Tailoring Co., Dept. 755, Chicago.

WANTED at once, Show Cards and Sign Writers or those with artistic taste who can follow my ideas and make good income at home or traveling. G. W. Miller, 2050 Amsterdam Avenue, New York.

BUSINESS OPPORTUNITIES

PATENTS—Book free. Send sketch for free opinion of patentable nature. Talbert & Talbert, 4847 Talbert Building, Washington, D. C.

100 FINEST quality cards, beautifully printed, and leatherette case stamped in gold, 85 cents postpaid. Write plainly. Raymond Card Company, 410 Superior Building, Cleveland, Ohio.

SUBSTANTIAL manufacturing corporation wants capable men to establish branch and manage salesmen. $300 to $2000 necessary. Will allow expenses to Baltimore as explained. Address Mr. Clemmer, 603 N. Eutaw St., Baltimore, Md.

MAKE Big Money making marble, onyx, agate, tile, etc., more beautiful and less than one-tenth cost of genuine. Marble and other fancy face brick, $15 thousand sell for $75. Cost of building reduced 25% to 50%. Experience unnecessary. Very little capital to start. Money-back guarantee if you fail with my instructions, based on 40 years' experience. Send for list of products and sample. B. F. Spencer, P. O. Box 213, Los Angeles, California.

ARE you satisfied with the success you have made in the past? If not, give our line a chance and we are positive that you will be pleased with its money making possibilities. Our $5.00 to $20.00 annual premium accident and sickness policies may be sold to men and women—16 to 65 years—all occupations pay same rate. Million Dollar asset Company, established 1886. Liberal commission and territory. North American Company, 308 Walnut Street, Philadelphia, Pennsylvania.

PATENTS Procured—Trade Marks Registered—A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 44 Owen Building, Washington, D. C., or 2276-Z Woolworth Building, New York.

EXPERT Chemist will furnish Formula and Trade Secrets in all lines. Lists free. W. L. Cummings, Ph.D., Gordon Avenue, Syracuse, New York.

VULCANIZING Auto Tires growing and profitable business, especially now. Easy to learn. Instruction Book $1. Plants $50 up. Catalogue free. Equipment Company, 151 Canal Street, Cincinnati, Ohio.

BE a detective. Excellent opportunity, good pay, travel. Write C. T. Ludwig, 424 Westover Bldg., Kansas City, Mo.

DOLLARS Yearly in your backyard. No mushroom dope. Particulars free. Mets, 313 East 89th, New York.

INSYDE tyres, inner armor for automobile tires double mileage and prevent punctures and blowouts. Quickly applied. Cost little. Demand tremendous. Profits unlimited. Details free. American Automobile Accessories Co., Dept. T-1812, Cincinnati, Ohio.

MAN or Woman, start anywhere; materials that cost equipment. Call or write for literature. Anderson Steam Vulcanizer Company, 2302 Grand Avenue, Kansas City, Missouri.

MR. BUSINESS MAN—would you like to be represented, and have the right to use a Newark Office address on your stationery and printed matter? I will represent any legitimate business for $2.50 a month or $20.00 a year. Send references with order to M. Ellis, 110 Riverside Avenue, Newark, New Jersey.

USED Correspondence Courses of all kinds sold. (Courses bought.) Lee Mountain, Pisgah, Alabama.

FOR sale—old established mail order manufacturing business. For particulars address Pioneer Aquarium, Racine, Wisconsin.

INVENTORS—My clients know every step taken in prosecuting their applications. Booklet sent free on request. Warner Cubberley, 20 National Union Bldg., Washington, D. C.

NEW Goods, Mail Order and Agents. Samples 15c; Catalog 2c. Harvey Teeple, Decatur, Indiana.

I MADE $30 a week evenings with a small mail-order business. Free Booklet tells how. 2c postage. Al Scott, Cohoes, New York.

TWENTIETH Century Book of Recipes, Formulas and Processes contains 10,000 items covering a broad list of subjects. It is a money maker, too, for many of the formulas could be made the foundation for a small business at home. 800 pages, cloth bound. Price, $4, postpaid. Swanson Bros., 186 No. La Salle St., Chicago.

SILVERING mirrors. Exclusive French tartaric process. Open enormously profitable business. Write P. Barstow, 514 23rd Street, Oakland, California.

FORTUNES made every year raising silver foxes. Easy to raise. Will not interfere with your regular employment. Booklet free. C. T. Drys, Box 1013, Eagle River, Wisconsin.

ENTER a new business. Earn $3,000 to $6,000 yearly in professional fees making and fitting a foot specialty; openings everywhere with all the trade you can attend to; easily learned by anyone at home in a few weeks, at small expense; no further capital required; no goods to buy, job hunting, soliciting or agency. Address Stephenson Laboratory, 15 Back Bay, Boston, Massachusetts.

WE start you in business, furnishing everything. Men and women, $30.00 to $100.00 weekly operating our "New System Specialty Candy Factories" anywhere. Opportunity lifetime. Booklet free. H. Ragsdale Company, East Orange, New Jersey.

GENERAL Manager Wanted, $3,000 to $10,000 a year income for one man every city; must open office or take desk room, appoint agents and introduce "FIREX"; sale every home, office, store, auto, factory, garage, public building, etc. Sales campaign free to those qualified. Few dollars capital makes big, quick money. FireX Company, Portland, Oregon.

BUY and exploit practical inventions. Trade for property. Form companies. Sell county rights. Adam Fisher Mfg. Co., 183D, St. Louis, Missouri.

DON'T miss this offer! You get new business, quick cash returns, using fresh names mail order buyers, compiled printed September 1920, farmers, rural folk, 2500, $5.00, trial 300, $1.00. Martinek 10 Company, 405 Lexington Avenue, New York.

MEN, get into the wonderful tailoring agency business, big profits taking orders and your own clothes free. We furnish fine sample outfit and everything free. No experience needed. Write today. Banner Tailoring Co., Dept. 756, Chicago.

PLUMBERS and Heating Men thinking of going into business for themselves soon, can hasten that time by sending at once to Niebuhrs Plumbers Business Bureau, 105 Fifth Street, La Crosse, Wisconsin, for confidential information regarding financing, accounting, estimating, etc.

START A Lucrative Business Of Your Own. We teach you how to establish and operate a successful collection business, and refer items to you. No capital necessary. Practically no competition. Walter Sanford, Nashville, reports $34,523.43 gross earnings last year. Jos. P. Cullet, Washington, sends sworn statement showing gross earnings of $8,039.07 for March. O. H. Overholser, Dayton, says: "I averaged over $360 net commissions monthly last year, and January shows $581.51 net. Such earnings bought my home and farm." Start now in spare time. You can succeed where 4,300 others have. Write today. Ask for "Pointers," and new plan. American Collection Service, 787 State Street, Detroit, Michigan.

EACH $4 for material makes $75; then each $75 makes $1,400. Easy to start this amazing new chemical business. 20,000,000 for steady customers. STEWART, 1106 Empire Building, Birmingham, Alabama.

START a cleaning, dyeing, and pressing shop in your own home. Large profits. Details free. A. A. Barnes, x5m, Helena, Arkansas.

SEND for free book, "How to Succeed in Real Estate Business." State occupation. Mac onald Cooperative Realty Company, San Diego, California.

DISTRIBUTORS and Dealers—Do you want to handle a real, live automobile accessory? Then write at once and secure the local sales rights for Pressed Steel Auto Lugs. They are almost a necessity where bad roads are found. A driver having a set of these lugs need never fear the worst kind of road. Simply attach to rear wheels and away you go. Can apply in less than a minute. Takes any automobile or truck out of mud, holes or ditches. Retails for $8.00 a set of four. Handsome commissions to dealers. An opportunity to make a lot of money. (It's some satisfaction to always have traction.) Sample set will be furnished if desired at retail price. Address World-Over Sales Company, 505 Fifth Avenue, New York City.

MAIL Order Business is your opportunity. Breniser's Famous Handbooks teach how to start small, grow big. Sell merchandise, service ideas; enormous profits. Spare time to begin. Get complete set, 11 books $2.50 and be posted. Breniser, 337 M. Walnut Street, Philadelphia. Descriptive catalogue and big batch interesting mail order information 25c. None free.

STAMPS AND COINS

51 different stamps, also packet 5 unused, China ship set, 2 scarce animal stamps, large $1.00 U. S. revenue, perforation gauge, millimeter scale, ruler and price lists. All for 9c. Sudden service approvals. Fennell Stamp Co., Dept. C., Fullerton Bldg., St. Louis, Missouri.

CALIFORNIA gold, quarter size, 27c; $5 size, 53c. White cent and catalogue 10c. Norman Shultz, King City Missouri.

500 different stamps $1.40; 200, 28c; 100, 12c; approvals. Michaels, 5600 Prairie, Chicago.

158 Genuine Foreign Stamps—Mexico War Issues, Venequela, Salvador and India Service, Guatemala, China, etc., only 10c. Finest Approval Sheets 50% to 60%. Agents wanted. Big 72-p. Lists Free. We buy stamps. Established 25 years. Husman Stamp Company, Dept. 55, St. Louis, Missouri.

STAMPS, 20 All Different, 3 cents. Mention paper. Quaker Stamp Co., Toledo, Ohio.

$2 to $600 paid for hundreds of old coins dated before 1895. Send 10 cents at once for new illustrated coin value book. Size 4x7. It may mean your fortune. Clarke & Co., Coin Dealers, Box 76, LeRoy, N. Y.

17 varieties Bulgaria stamps, 20c. List of 7,000 varieties low priced stamps free. Chambers Stamp Co., 111C, Nassau Street, New York City.

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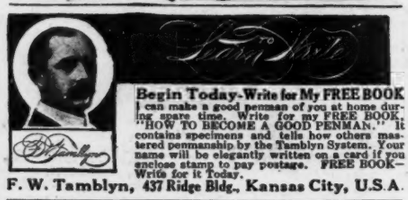

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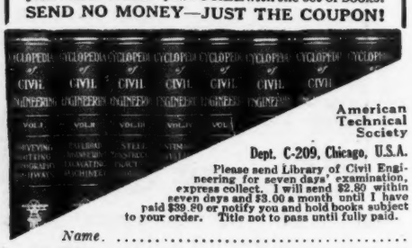

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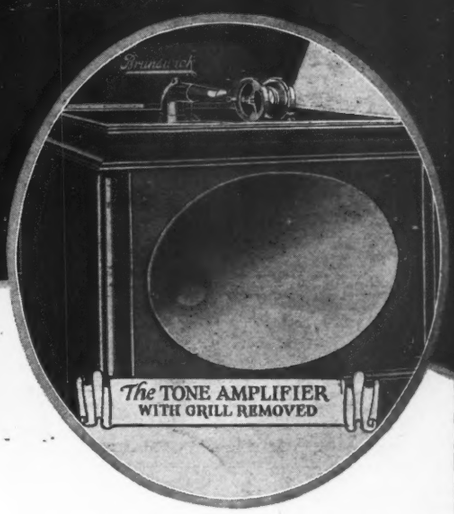

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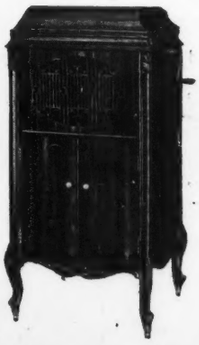

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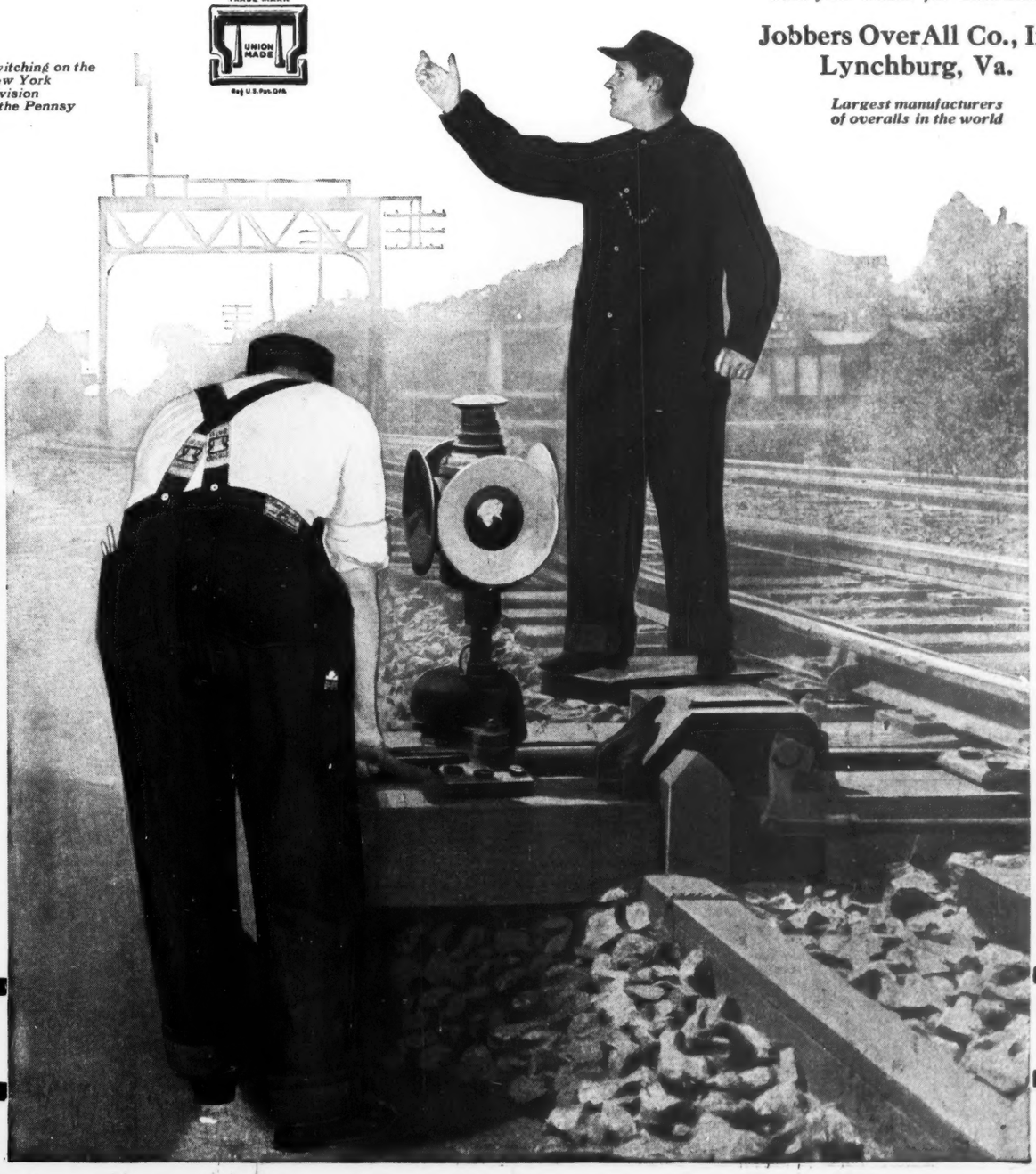

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